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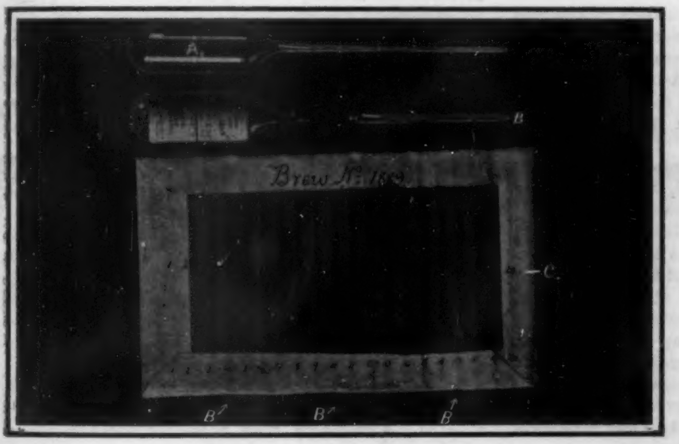
Exhausting the air of the bottles. After the vacuum is created the necks of the bottles are sealed and broken off.

After incubation the germs are killed and carbolized.

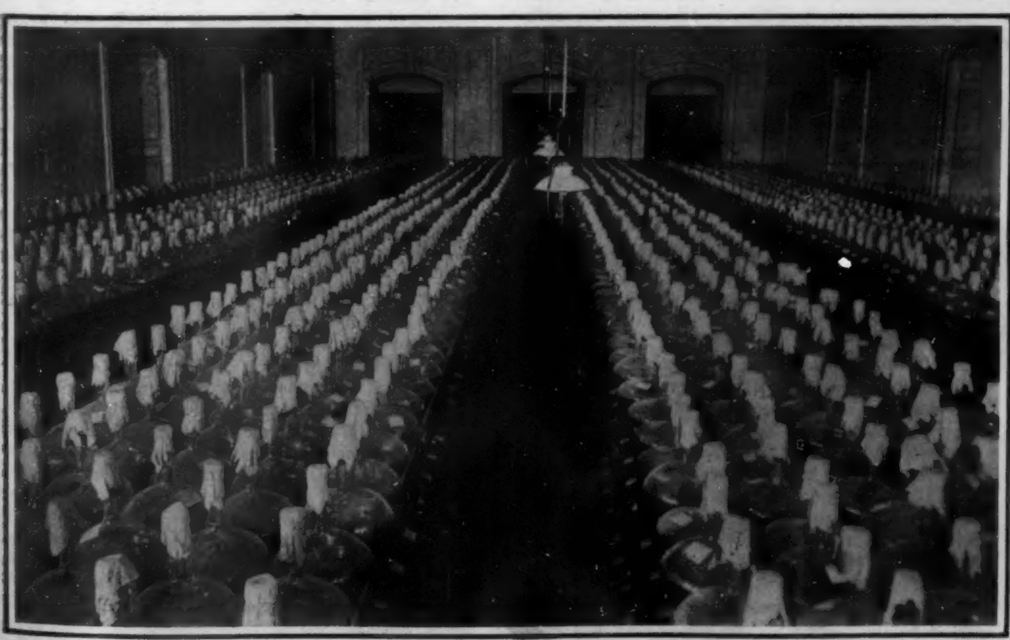


A. The bottle after it has received its charge of vaccine. B. The sealed neck containing a small proportion of the bottle contents. C. The receptacle in which the laboratory preserves the samples of vaccine.

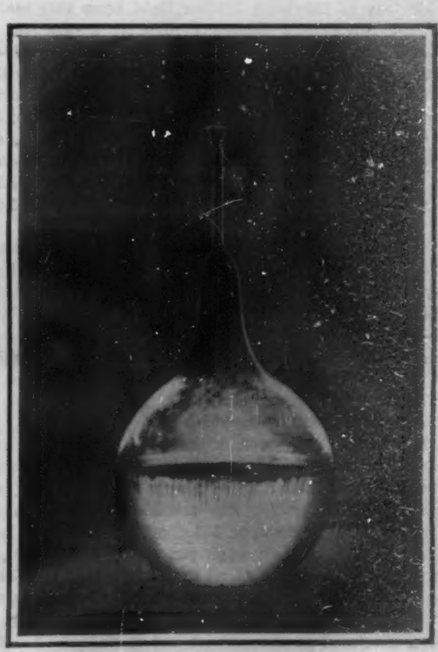
The vaccine phials.

Each flask containing the boiled, filtered, and decanted liquid is passed into a large sterilizer and subjected to saturated steam at 30 pounds pressure. The result is a clear, sterile broth.

Decanting the vaccine into the bottles.



The incubating room. Here the germ broth is left in darkness for six weeks, during which the organisms multiply enormously.



Testing the culture for identification.

HOW INDIA IS FIGHTING THE PLAGUE—THE MANUFACTURE AND USE OF ANTI-PLAGUE VACCINE.—[See page 373.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, NOVEMBER 28, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TECHNICAL HEADS FOR TECHNICAL CITY DEPARTMENTS.

The costly blunder which has recently been discovered in the design of the Blackwell's Island Bridge, raises the question of the desirability, we had almost said the imperative necessity, of having technically qualified men at the head of such highly technical departments as that of bridges. We say this without the least intention to disparage the present Commissioner of Bridges, or any of the gentlemen who have preceded him that did not happen to possess the training of a civil engineer. With one exception, the present and former Mayors of this city have not considered it necessary that the Commissioner of the Department of Bridges should be a bridge engineer. It has been the custom for the newly-appointed Commissioner to select a chief engineer, and hold him responsible for all the strictly technical matters pertaining to the work of the Department.

But would it not be much more satisfactory if, in the future, the Mayors of this city, in looking for a Commissioner, selected from among the many eminent and fully qualified bridge engineers of the country a man who combined in himself the professional knowledge and administrative ability required for this enormously responsible position? If, during the past decade, in which three of our most important bridges have been constructed or commenced, the Bridge Commissioner had been a qualified engineer, we are satisfied that mistakes would have been avoided, many economies achieved, and above all the colossal blunder of the Blackwell's Island Bridge would never have occurred.

By way of throwing further light upon this matter of the Blackwell's Island Bridge, it should be explained that, in the bridge as originally designed, the congested live load was very much less than that which was subsequently adopted. The contract drawings were made for a bridge with six tracks (two elevated and four trolley), a roadway for vehicles, and two sidewalks; the maximum loading being set down at 12,600 pounds per lineal foot of the bridge. After the contract was made there came a change of administration and engineers, and under the new *régime* it was decided to increase the number of elevated tracks from two to four by adding two tracks to those already provided for on the upper deck of the bridge. This change involved an increase, first in the live load, which was raised from 12,600 pounds to 16,000 pounds per lineal foot for congested loading; and, secondly, in the dead weight of the bridge itself, due to the enlargement of the sections of the bridge to meet the heavier live loads thus imposed.

Now we believe it is a fact that when this most important revision of the plans occurred, the present Commissioner had not been appointed to office, and the responsibility for the mistakes which followed cannot therefore lie upon his shoulders. His predecessor also was not an engineer, for had he been, he would have made it his first duty to see that the bridge was entirely redesigned, and an entirely new strain sheet drawn up. Whether this was done has not yet been disclosed to the public; but it cannot be denied that the extraordinary conditions revealed by the investigations of Prof. Burr and Messrs. Boller & Hodge would seem to suggest that the increase in the strength of the bridge was made by some rough-and-ready method of percentages.

The conditions revealed by these reports are so disconcerting, so strongly suggestive of gross incapacity somewhere in the Department, that we think the matter should be made the subject of a searching investigation, similar to that which followed the fall of the Quebec Bridge. It is only by getting at the real facts of the case, and disclosing to public view the history of the design and construction of this bridge, that the city can be placed in a position intelligently to make such reforms in the Bridge Department as are necessary.

MAKING ROCKS AND MINERALS ARTIFICIALLY.

The completion of the Geophysical Laboratory of the Carnegie Institution of Washington puts at the disposal of investigators attacking the many problems connected with the physics of the earth unique facilities in the way of organization and equipment. The new laboratory was erected especially for this purpose at a cost of $100,000. A staff of expert and special investigators under the general direction of Dr. Arthur L. Day is engaged on researches of considerable importance, as they are designed to supply information in fields where present scientific knowledge is all too scanty.

The science of geophysics is typical of a modern tendency to unite in a single field certain elements of two or more of the older sciences. In geophysics there is an application of pure physics and pure chemistry to the data supplied by the geologist and mineralogist, or in other words a blending of physical or exact science, so far as the study of the earth is concerned, with natural and descriptive science. The phenomena presented by the earth to-day are due to the action of chemial and physical forces, and these phenomena range all the way from the most minute crystal to the earth itself in its relation to other celestial bodies. Now in the geophysical laboratory these phenomena are studied quantitatively by experimental methods.

One of the first tasks of the geophysicist is to study from surface conditions the nature of the interior of the earth and investigate the distribution of different materials and more especially the conditions under which they exist, such as temperature, pressure, density, and other characteristics. Accordingly if the nature of the interior materials of the earth and the temperature conditions are known it is possible to reach definite conclusions as to the nature of the formative processes, while if the distribution of pressure is studied it is possible to gain a more adequate idea of earthquakes and their transmission.

At the Carnegie Institution Laboratory the chief work at present is a study of rocks and their formation. Now the ordinary geologist studies the outside appearance of rocks and minerals at the surface of the earth, but the rocks and minerals so found are by no means pure, because so many kinds of action have been at work at different times that the ultimate result is different from that occasioned by the combination of simple substances under elemental conditions. So at great pains and trouble, after a mineral has been analyzed, the experimenter, using perfectly pure substances, combines them to form a chemically pure mineral. The chemical and physical properties of the artificial mineral are studied in comparison with its natural prototype, and knowing with accuracy not only its constituents, but the processes by which it was formed, it is possible to determine the nature and extent of the processes of nature. Thus a new and real science of mineralogy is being built up by the geophysicists, a science which shows quantitatively the combining conditions of rocks. Incidentally such studies often lead to matters of great economic and practical importance. For example, in the study of calcium oxide and silica, two constituents most frequently found in rock and also essential materials of Portland cement, it was demonstrated that they could combine only in certain ways and in certain proportions and not in the way that had been assumed by cement manufacturers. Now the basis of combination of these two oxides being understood, it will of course provide the cement maker with a scientific basis on which to prepare his product, replacing arbitrary and rule-of-thumb methods. Then again the question of adding alumina to a mineral combination is under consideration, as that substance also figures in many important minerals, as well as being essential to cement, and the results of the investigation may have an important bearing on that industry.

Another practical field in which these investigations of mineral formation seem destined to play an important part is in the study of ore deposits. If the fundamental conditions under which ores are formed are thoroughly understood, then the range of practical geology is widely extended and the amount of ore bodies available for economic exploitation can be materially increased.

In reproducing the original constructive processes of mineral formation in the experimental laboratory, the first requirement is the application of intense heat whose degree and quantity can be measured with accuracy. This of course is a difficult undertaking, but with exact thermometric measurements to establish the points at which various minerals act on one another to form certain combinations careful laboratory work can be carried on along definite and determined lines. With the apparatus of the Geophysical Laboratory high temperature measurements can be made up to 1,500 deg. C. with an accuracy of one degree, and between that point and 1,600 deg. C. with an accuracy of two degrees, so that it is possible to realize almost the precision of ordinary mercurial thermometry. This is important, as most minerals are formed below 1,600 deg. C., but above this temperature measurements can be made by optical methods of pyrometry even to the temperature of the sun with the error diminishing rapidly as better apparatus is invented. The mixtures of minerals to be subjected to the action of heat are inclosed in strong steel bombs and then placed in electric furnaces where any desired degree of heat can be maintained constant for several weeks or months as desired, generators, transformers, and storage batteries supplying adequate current. Using the Nernst arc and iridium crucible furnace a temperature as high as 1,800 deg. C. can be obtained, and this to-day represents practically the maximum temperature available for exact experimental investigations on minerals. The investigator concerned with studying various rock formations subjects the minerals to the action of intense heat, noting the temperature at which they react or the point on the selected scale of temperature at which melting or fusing occurs. For every such phenomenon or chemical reaction there is either a gain or loss of heat, and this can be measured by calorimetric processes which have been developed to a high degree of accuracy at the Geophysical Laboratory.

The product of combination of two or more minerals is then studied, and what is more, the artificial is compared with the natural mineral, chemist, physicist, and mineralogist uniting in the examination and employing the microscope and polariscope among other methods and making a record of the mineral by photomicrography, for which the laboratory contains a special equipment. Should any striking differences be found the reasons for these must be investigated, and especially the presence of impurities, which often occur naturally in a mineral that in the laboratory may be made from chemically pure components without any disturbing influences. By the introduction of a third substance the problem becomes slightly more complicated and the range of the investigation extended, but the results are no less sure and interesting.

After high temperature work the effects of intense pressures must be considered, and the Geophysical Laboratory has on its staff one of the most expert men in the world for high-pressure research. He was the first to make liquid carbon and came to the laboratory from Europe especially to advance this side of its work. Thus it is known that to produce diamonds and other precious stones artificially, extremes of pressure, to imitate the forces of nature, are demanded. Accordingly such pressures are applied to the reactions taking place in the electric furnace, and while the production of gems artificially is no more an object of study than the formation of any other minerals the study is interesting as showing where such investigations may lead.

In addition to temperature and pressure must be considered the effect of carbon dioxide and water vapor in their solvent action on the earth in forming minerals. The relation of water to the combining conditions of minerals is most important, and the universal presence of water and carbon dioxide in all natural rocks forces the belief that it is an important if not a controlling factor. To investigate this, steel bombs of great strength are filled with the minerals. Water vapor or carbon dioxide at pressure is introduced, and the rock is reproduced by imitating original conditions. On account of the great pressures the action goes on faster and at lower temperatures than in nature, and as the effect of the carbon dioxide is entirely unknown the outcome of this investigation is being looked forward to with great interest.

The conductivity of rocks for heat is another property that must be studied in order to understand volcanoes and their phenomena, and especially to determine the effects of the intrusion of lava or other liquid rock into the cracks of the solid rock. The thermal properties of the earth-forming materials afford a most promising field for investigation and here the scientific staff of the laboratory is at present concentrating its attention. In addition there are many other properties as worthy of attention. A study of the elastic properties of matter as involved in the materials of the crust of the earth is now being undertaken at the laboratory by Dr. George F. Becker of the U. S. Geological Survey. This investigation deals with the relation between the force exerted on rocks and their displacement with the idea of determining quantitatively how and what forces have been at work to bring about the various displacements and changes noted by geologists.

ENGINEERING.

As a sure indication of returning business prosperity, it is gratifying to learn from the committee of the American Railway Association on power efficiency that the decrease in the number of idle cars continues, the total number being now reduced to less than 100,000. Analysis of the returns shows that as the demand for cars increases, the roads are repairing the cars that were temporarily unfit for duty, and are placing them in active service.

The record for rapidity in excavation is continually being broken at the Isthmus of Panama. The latest instance occurred on October 22, when 313 10-yard dump cars were loaded in 370 minutes, an average of 1 minute and 11 seconds per car. Assuming that they were loaded to their full capacity, a cubic yard of material was placed on the cars every 7 seconds. The only interruptions occurred when the dipper was cleaned and the shovel moved forward to a new position.

The school of target practice established on the battleship "Sardegna" by the Italian Minister of Marine has shown excellent results. The competition for the gunlayers' prize was carried on from ships which were steaming at a speed of 14 knots at a little under 3,000 yards past a target measuring 23 feet by 56 feet for the heavier guns, and 10 feet by 30 feet for small guns. The average for all the ships was 60 per cent of hits, and on some ships it rose to 75 per cent.

According to the report of the United States Geological Survey on the petroleum industry for 1907, nearly 18,855,691 barrels of oil were consumed that year as fuel by the railroads of the United States. This is an increase of over 3,000,000 barrels above the amount used for the purpose during the preceding year. It is estimated that 13,593 miles of railroad were operated by the use of fuel oil, and the total mileage by oil-burning locomotives is estimated at over 74,000,000.

The new Lackawanna tunnel through the Bergen Hills in Jersey City, which has been driven to provide two additional tracks and extends parallel with the old tunnel, is nearing completion. It has been built to facilitate the handling of the heavy suburban traffic of the road. With a view to the probable future electrification of the system, connections are being sunk in the roof for carrying the electric conductors. The opening of the tunnel will take place early in December of the present year.

The largest dredger in the world, the "Leviathan," recently launched for the Mersey Docks and Harbor Board, is 487 feet long, 69 feet broad, and 30 feet 7 inches deep. Her pumps are capable of dredging 10,000 tons of sand into her bunkers in 50 minutes from a maximum depth of 70 feet, and she can carry these 10,000 tons out to sea at a speed of 10 knots. The dredging plant consists of four sets of engines, driving four centrifugal pumps connected to two 42-inch suction tubes on each side of the vessel.

The wooden schoolship "St. Mary's," after sixty years of service, first as a warship, and latterly as a schoolship in the service of New York, has been bought by a Boston firm for junk at a price of $5,000, and is being broken up for the metal that is in her. Sixty years ago she was one of the fastest warships in the United States navy. From 1874 until October of the present year, when her place was taken by the "Newport," over 1,000 boys had passed through this famous old vessel, and graduated from her after taking a two years' course in navigation and seamanship.

Evidence of the profound impression made upon France by Wilbur Wright's recent success with his aeroplane is shown by the statement in the Army and Navy Gazette that the French Ministry of Marine are seriously considering the placing of an order for a large number of aeroplanes of the Wright type for the Coast Guard Service. It is reported that a member of the Army Commission of the Chamber of Deputies, who witnessed Wright's feat of flying for over an hour with a passenger on board, stated that the aeroplane has now been developed to a point where it will be of great value for military scouting.

Travel between New York and Brooklyn has seen a remarkable increase during the past year. The total travel in both directions for twenty-four hours was 816,000 as compared with 706,000 last year, an increase of about 16 per cent. The opening of the Subway tunnel and the growing traffic over the Williamsburg Bridge have caused a decrease of travel over the Brooklyn Bridge from 423,000 in 1907 to 310,000 in 1908. An analysis of the traffic across the East River shows that the ferries carried 165,000; the Subway, 160,000; Williamsburg Bridge, 182,000; and Brooklyn Bridge, 310,000. Nothing could show more forcibly than do these figures the commanding position held by the famous Brooklyn Bridge among the transportation facilities between Manhattan Island and Long Island.

ELECTRICITY.

The superintendent of the Hackettstown Electric Light Company reports that during a severe storm last summer, a severe lightning discharge passed through thirty-three series tungsten lamps. The film cut-outs in the sockets were punctured, but when these were replaced, the lamps were found to be undamaged except for a slight twisting of the filament.

A very effective gas lamp has recently been introduced, which has every appearance of an arc lamp, but gives a softer and more steady light. It consists of incandescent gas mantles, which are inverted so as to throw all the light downward. The mantles are protected by a globe of ground glass, which distributes the light and conceals the fact that the lamp uses gas instead of electricity.

The efficiency of wireless telegraph for communication between the earth and balloons or airships was recently tested near Brussels. Messages were successfully transmitted to a balloon, which also received signals from the Eiffel Tower in Paris. One of the objections to wireless apparatus in a balloon is the danger of igniting the gas with sparks generated by the apparatus.

Many strong arguments are being advanced for the installation of 25-volt wiring in buildings, so as to permit the use of tungsten and tantalum lamps. The principal advantage is that the same candle-power may be obtained with a much shorter and stronger filament. Furthermore, the lights can be run at a higher efficiency. To be sure, a transformer will be necessary, but the cost of the transformer would soon be made up by the greater efficiency of the lamps.

At the recent electrical exhibition in Manchester, a novel arc lamp was shown, which was provided with carbon magazines. The carbons are arranged in the form of flaming arc, one of the magazines being stationary, and the other movable, so as to bring the carbons in contact when starting the lamp, and to permit of adjusting the carbons so as to regulate the arc. The mechanism feeds the carbons steadily, and as soon as a carbon burns out another one is brought into play, the burnt-out carbons dropping into the globe of the lamp.

The Public Service Commission has granted permission for the building of an electric monorail road between Bartow Station on the New York, New Haven and Hartford Railroad and Belden Point, City Island. This will be the first passenger monorail to be built in this country. The system will be similar to that used on the experimental road at the Jamestown Exposition. The cars will run on a single rail at the ground, and will be prevented from toppling over by a pair of guide rails above.

One of the indispensables of torrid India is the punkah, or large fan, which is operated by a colored servant to secure a draft of air and keep insects from disturbing the sleeper. The native is not always reliable, being apt to doze, and for this reason efforts have been made to devise a mechanically-driven punkah. These efforts have failed, owing to the difficulty of duplicating the action of the hand-worked punkah, the special value of which consists in the sudden jerk given the fan by the native at each turn. Recently an electrically-driven punkah has been devised, according to the Electrical Review and Western Electrician, in which this jerking motion is perfectly imitated by a "lath-shaped spring" covered with leather, which slaps the fan to and fro.

In German cities and towns considerable attention is paid to the generation of electricity from heat obtained in the destruction of refuse. Statistics for a number of German towns show that one kilogramme of refuse yields from 0.6 kilogramme to 1 kilogramme of steam at a pressure of 8 to 12 atmospheres. The following table has been compiled to show how much electrical energy should be obtained per day in cities of different size:

Inhabitants.	Kg.	Kw-hours.
250,000	286	2,500,000
100,000	104	911,000
50,000	47	411,000
20,000	17	149,000

Since the middle of May the St. Clair tunnel, running between Sarnia, Ont., and Port Huron, Mich., has been operated with electric locomotives. The operation has been in charge of the contractors, in order to thoroughly test the equipment. On the 12th of this month the tunnel was handed over to the Grand Trunk Railroad. The St. Clair tunnel is 6,032 feet long, with a two per cent grade at each end. Heretofore it has been necessary to break up the freight trains at each terminal into separate sections, so that they could safely be drawn through the tunnel by a single steam locomotive. The use of electric locomotives eliminates the danger of suffocation in the tunnel, and permits long freight trains to be drawn through, thus saving considerable time, which heretofore has been used in making up the sections.

SCIENCE.

The latest medical protest against the smoke nuisance comes from Dr. John T. Wainwright, who points out in the Medical Record that sunlight and health are almost synonymous terms, and that smoke means noxious gases. To drive home his point, he cites as modern instances the smoky towns of Manchester and Leeds and their notoriously high death rate. There is also a commercial side to the question. A Chicago merchant maintains that smoke damages $200,000 worth of his goods every year, which seems suspiciously but not incredibly high.

The tuberculosis exhibits of the recent International Tuberculosis Congress have been sent to New York, and are to be set up at the American Museum of Natural History. The exhibit, by far the largest of its kind ever collected, will be on view for at least six weeks, in which time there will be many public meetings and conferences on the prevention and treatment of tuberculosis. These are expected to extend the interest in the exhibit itself and increase its educational value. The exhibit will be open to the public from 10 o'clock in the morning until 10:30 at night daily and on Sunday afternoons.

A report for the calendar year 1907, just issued by the United States Geological Survey, contains the startling announcement that the total production of our mineral resources is valued at more than $2,000,000,000. This means an increase ranging from 5 to 40 per cent. The largest contributions to the mineral wealth of the year were made by coal and iron, which together represented considerably more than half of the total. The value of the coal mined showed a gain of about 15 per cent on 1906. The increase in iron was somewhat less.

The Pennsylvania Railroad recently sent out an instruction train for a three days' trip through eastern Pennsylvania, to deliver free lectures to the farmers along the line. The lecturers were members of the faculty of the State College of Agriculture. The three coaches of the train were fitted up as lecture rooms, and at each of the twenty-two stops forty-five-minute talks were made. Besides lectures on increasing the fertility of the soil, there were discourses on methods for increasing the output of dairy products, the care of live stock, testing seed corn and the cultivation of alfalfa.

The devastation of the Hudson River Palisades, now happily averted by law, finds its counterpart in the threatened destruction of the famous Giants' Causeway. Americans are usually branded as unsentimental, money-making despoilers of nature. Guilty as we have unquestionably been, it is doubtful if we have ever outdone the despoliation of the Giants' Causeway, which is now occurring at the hands of a British syndicate. The basalt of which the Causeway is composed is an excellent road-making material, and to be trodden under foot seems now its ultimate fate. This latest bit of vandalism is in large measure due to the automobile. The advent of the high-speed motor car has brought about a necessary improvement in the macadam road, and the best possible road is made by the Irish basalt of which the Giants' Causeway is constituted.

At one time a large part of the potassium nitrate used in the manufacture of gunpowder was obtained from natural and artificial niter beds, by leaching out the niter which formed on the surface of stones and rubbish exposed to humidity and sprinkled with liquid excrement. During the wars of the French Revolution and Empire, when it was impossible to import niter from India, artificial niter beds were established in every part of France. The Committee of Public Safety published instructions concerning their operation and Fourcroy devoted many pages to them in the Encyclopedia. This crude process is now being revived, after having been abandoned for a century. Müntz and Bazin have taken out patents for a method by which farmers can produce for their own use fertilizers rich in nitrates, which may be substituted for Chile saltpeter, which is increasing in price year by year. The process differs very little from that of olden times, except that stones and rubbish are replaced by peat, which is peculiarly well adapted for nitrification, very cheap and naturally rich in nitrogen. Advantage has also been taken of the discoveries of bacteriologists in regard to the properties and functions of nitrifying microbes. Dry peat is ground and mixed with one-tenth of its weight of chalk, half its weight of water and a little phosphate of lime. The mixture is placed, in a bed about three feet deep, in a building where the temperature can be kept constantly at about 70 or 75 deg. F. The bed is then sprinkled with a solution of ammonium sulphate or any other ammoniacal liquid, such as sewage, factory waste, liquid manure, or the ammoniacal liquor of gas works. Within one month all the ammonia is converted into nitrate. The mixture can then be either used directly as a fertilizer or leached for the extraction of the niter, which can be purified and sold for industrial purposes.

THE ECLIPSE OF THE SUN AND LUNAR APPULSE IN DECEMBER, 1908.

BY FREDERIC R. HONEY, TRINITY COLLEGE.

The movements of the celestial bodies which characterize each year, are those which mark that period with special interest for the student of astronomy. The year 1907 was distinguished by the brilliant opportunity it afforded for observing our neighbor planet at opposition; and also for the rare recurrence of the November transit of Mercury which will be seen only nine times during the present century. The year 1908 has shown nothing of this particular nature; but it is distinguished for the three eclipse seasons which it includes. The occurrence of three eclipse seasons in one year is possible only when we have an eclipse very near the beginning of the year; and this is only possible at intervals of every nine years. The year 1899 included three eclipse seasons.

The plot, Fig. 1, illustrates the gradual advance of the dates of eclipses in 1908. The position of the earth is shown for the dates of the solar eclipses of January 3, June 28, and December 23; also for the lunar appulse of December 7.

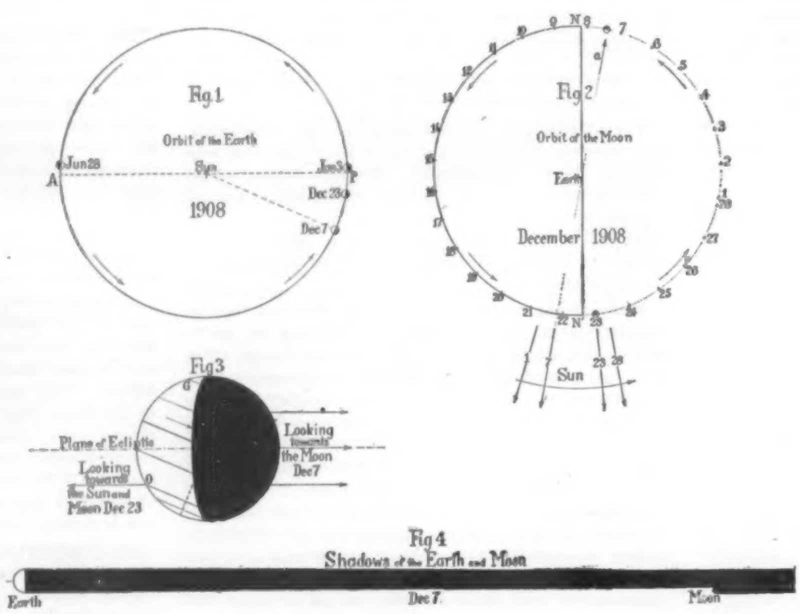
Fig. 2 is a plot of the moon's orbit for December. That part which is represented by the full line is above, and the part shown by the dotted line is below the plane of the ecliptic. The point N is the ascending node where the moon passes from the space below to that above the plane of the ecliptic; N', the descending node, is the point where she passes from the space above to that below; and NN', the line of nodes, is the intersection of the plane of the moon's orbit with that of the ecliptic. The position of the moon is shown for each day from the 1st to the 28th at Greenwich noon; and also at the time of the appulse, when the moon will be below the plane of the ecliptic, and will graze the earth's shadow. The moon's position at the time of the eclipse practically coincides with that given in the plot for the 23d, since the eclipse will occur between ten and eleven minutes before Greenwich noon. The direction in which the sun is seen from the earth is shown for the 1st and the 28th at Greenwich noon; also for the 7th and the 23d at the time of the appulse and of the eclipse. The sun and moon appear to move in the direction of the arrows, and are represented by their longitudes. At the date of full moon, when the longitude of the sun and moon differ by 180 deg., the sun's rays in the direction of the arrow a illuminate the hemisphere which is visible from the earth. The time of full moon is 7d. 9h. 44m.; and that of the nearest approach of the moon to the earth's shadow is 7d. 9h. 55m.

Fig. 3 is a projection of the earth on a plane which is parallel to its axis and perpendicular to the plane of the ecliptic. In this projection the equator, tropics, polar circles, parallel of Greenwich, and that of an observer to whom the central eclipse will be visible at noon, are represented by straight lines. The figure represents the illuminated area and that which is in shade at the time of the appulse.

Fig. 4, drawn to scale, represents the earth, the moon, and their shadows, projected on a plane which is perpendicular to the plane of the ecliptic, and parallel to the earth's orbit radius on December 7 (Fig. 1). The length of the shadows of the earth and of the moon vary during the year. They are longest when the earth is at aphelion, and shortest when it is at perihelion. It is impossible to include them within the limits of this page. The length of the moon's shadow does not differ very much from the length of the moon's orbit radius, i. e., the distance between the earth and moon in Fig. 4; and the length of the earth's shadow is about three and two-thirds that measurement. That the moon's shadow on the average is about the same length as the radius of the moon's orbit is shown in a solar eclipse. In the case of an annular eclipse, the shadow does not reach the earth. When the eclipse is total the shadow is longer, and its vertex may fall some distance beyond the earth's surface.

On December 23, the date of the central eclipse of the sun, when the moon will be below the plane of the ecliptic (Fig. 2), the position of the observer (also below the plane of the ecliptic) to whom a central eclipse will be visible at noon is shown at O in latitude 53 deg. ¾ sec. (Fig. 3). Since the longitude of the observer is only 2½ deg. east of Greenwich, and the date is near that of the winter solstice, the meridians of Greenwich and of the observer are, in the drawing, indistinguishable from the great circle which represents the earth.

Fig. 3 represents the earth on December 7. On the 23d the illuminated area will extend over a little more than one-half of the visible hemisphere. At the solstices the visible illuminated and unilluminated surfaces are equal, because the projection is on a plane which is parallel to the earth's orbit radius. At the date of the eclipse the moon will not be far from perigee (P) which she will reach on the 26th (Fig. 2). Her apparent diameter will not differ very much from its maximum. The earth will be near perihelion, and the apparent diameter of the sun will be nearly equal to its maximum. The result will be a total eclipse within a limited area, i. e., between longitudes 28 deg. W. and 38¼ deg. E.; and beyond these limits the central eclipse will be annular. The path of totality will be limited to the South Atlantic Ocean, for which reason the eclipse will have purely an academic interest for inhabitants of the United States.



THE ECLIPSE OF THE SUN AND THE LUNAR APPULSE IN DECEMBER, 1908.

LAUNCH OF THE "NORTH DAKOTA."

In the Scientific American of November 14 we published a sketch of the "North Dakota," showing the completed ship as she will appear when viewed from abeam, and we supplement that illustration with views showing the great ship a few minutes after she had taken the water. The photograph gives an excellent impression of the huge bulk of the vessel and of the high freeboard which she will carry forward, where it will be serviceable in keeping her batteries dry when she is steaming head to sea. We draw attention to the considerable flare which she has at the bow above water. This is a feature which is being generally adopted among the latest ships, and particularly in those of the Japanese navy.

The ship's flaring bow will serve to throw off broken water that otherwise might come aboard, making things uncomfortable for the gun sighters by dimming the telescopic sights. Although the "North Dakota" is a turbine-driven ship, she has but two propellers instead of the four propellers which we are accustomed to associate with turbine marine engines. The possession of only two propellers is due to the fact that this ship is furnished with turbines of the Curtis type, one of the advantages of which is that the speed of revolution is comparatively low, a fact which renders it possible to develop the power on two shafts, and use propellers of larger diameter and more efficient design. The "North Dakota" is of 20,000 tons displacement and 21 knots speed, and she will mount ten 12-inch guns in five turrets and fourteen 5-inch guns in casemates.

Displacement: 20,000 tons. **Speed,** 21 knots. **Guns,** ten 12-inch, fourteen 5-inch. Note the lofty forecastle deck and flaring bow.

LAUNCH OF THE "NORTH DAKOTA."

Device for Pre-cooling Green Fruit.

The Southern Pacific Company has just announced that a pre-cooling device for preventing decay of fruit and vegetables on which more than $100,000 has been expended during the past year has proved very successful and has been adopted. This means much in the movement of green fruit from California to the East. Pre-cooling plants will be established at Roseville and Colton, Cal., where the experiment work has been carried on—one for the northern route and one for the southern, in connection with the expenditure of more than $100,000 for ice-producing plants.

Forty carloads at a time can be thoroughly chilled within four hours at the Colton plant and twenty carloads at the Roseville plant, where to get the same degree of chill it would take four days in the ordinary ice plant. The experiments of the Department of Agriculture, which has been working with the fruit shippers and the Southern Pacific, demonstrate that the greatest value lies in the rapid reduction in temperature which suspends absolutely the decaying process of nature.

Air blasts passing over ice are forced into the cars by vacuum exhaust which in itself removes the immediate chemical cause of decay.

Green deciduous fruit shipments this year are 3,000 carloads in excess of any previous year and it is believed that with the adoption of this system the shipments can easily be increased to 20,000 per year.

A machine has been designed to show the actual working time of any or all machines in a shop, so as to give an accurate record of the cost of production. It is to show whether the machine has been working its full quota of hours, and, if so, to see if the output is in accordance with the rate set. After the time for handling the work in and out of the machine has been determined, it is easy to see whether it has been left running or not during the day. The records can be arranged to suit the conditions, and certain forms have the lower part perforated, so that the total for the day can be torn off for the works manager to see at a glance how many hours the machines have been working during the day.

IS CONCRETE STEEL A PERMANENT CONSTRUCTION?

BY J. A. FITZPATRICK.

An unusual example of deterioration of steel framing in buildings was recently discovered in the basement floor of the Eastern Power Station operated by the Brooklyn Heights Railroad Company at Kent and Division Avenues, Brooklyn.

The basement floor of the engine-room portion of the station is divided by the masonry engine foundations into several parallel galleries, each ten feet wide and running the full width of the building. A sub-basement or cellar, about six feet below the basement floor, leaves a clear space of less than five feet between the two floors. On this cellar floor rest the jet condensers for the engines above.

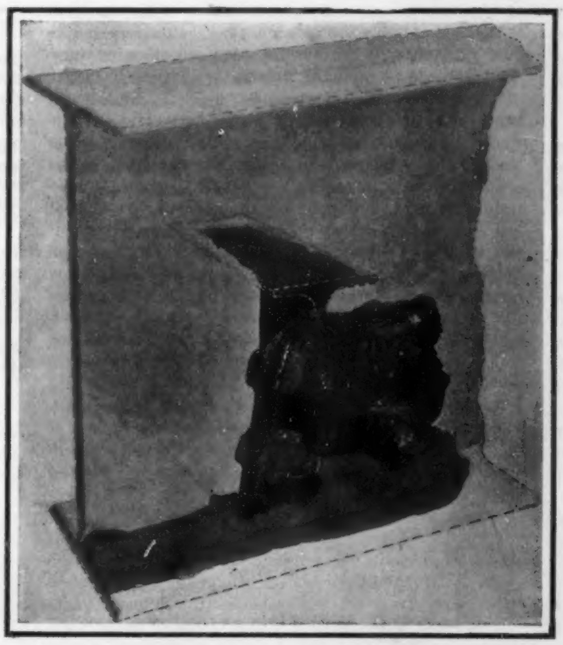
The basement-floor construction consisted of 6 and 7-inch steel I-beams framing into 15-inch steel I-beam girders. Between the beams were segmental concrete arches, stiffened by a wrought-iron mesh center. These arches did not cover the bottom of the beams, but left the flange exposed except for an occasional coat of paint received in the early history of the station. The steel frame was erected by the Berlin Iron Company in 1890.

Considerable rust was noticed on the exposed beam flanges; and as some of these appeared to sag in the center, a section of arch was removed, to see the condition of the upper portions of the beams. In only a few cases was there any upper portion left, the steel having corroded to such an extent that the webs and top flanges had disappeared entirely, leaving only rust on the adjoining concrete. The floor, instead of being supported by the steel framing, was in reality carried by the three-inch slab of concrete covering the tops of the arches.

The writer carefully investigated the locality, finding the following condition to exist:

The condensers employ salt water in their operation, and much of this is ejected in the form of spray on all sides of the condenser pits. There being no chance of drainage, this has been allowed to settle for years in pools on the floor, and together with the exhaust steam from the engines above, which found its way into the cellar, the atmosphere in the space between the two floors was kept continuously moist. This moisture was absorbed by the concrete arches, and held as if in a sponge, close against the web and upper flanges of the beams. The decomposition was probably slow at first; but as the chemical action progressed, a space was made between the steel and the concrete, leaving a space for air to enter, thus accelerating the chemical action. The exposed bottom flanges were in far better condition than the inclosed portions of the steel, this probably being due to the paint they received.

The wrought-iron bolts throughout the work were in an almost perfect state of preservation. This was in better condition than the material in the beams. The bolts, as mentioned before, were made of wrought iron, but the rivets were of rather a soft grade of steel, while the beams were of the hardest grade of steel that the writer has ever seen used in construction work. This leaves an open question as to whether the hardening elements in the high-grade steel, carbon and manganese, did not assist in the decomposition.



The shadow sections show the original size of the 7-inch and 15-inch I-beams when the floor was constructed. They were eaten away by rust until nothing was left but the portions shown in dark tint, which are reproduced from a photograph.

Deterioration of steel and concrete floor.

The main sewer draining the residential section of Williamsburg flows past the station on the north side, emptying into Wallabout Creek a few feet away from the mouth of the intake tunnel which supplies the water for the condensers. Traces of chlorine have frequently been detected in the basement, and this has undoubtedly assisted in the decomposition of the beams.

This was also found to be true of the wrought-iron mesh centers under the arches.

The illustration reproduced here shows typical examples of the 6 and 7-inch beams framing into the 15-inch beam girders. The steel being worn to a knife edge on the flanges, and the small portion of webs remaining, evidently show the effect of electrolysis.

The almost perfect preservation of the bolts is also shown, and it will be noticed that the shop rivets are

HOW INDIA IS FIGHTING THE PLAGUE—THE MANUFACTURE AND USE OF ANTI-PLAGUE VACCINE.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

One of the most important and best-known scientific institutions in India is the Bombay Bacteriological Laboratory at Parel. For some twelve years it has been the scene of many notable achievements in the subjugation of the terrible epidemic which has ravaged the country. At first only a small plague-research laboratory, started by Mr. Haffkine, it has developed into an extensive institution having a wide field of investigation. Here it was that Mr. Haffkine first evolved and prepared his "plague prophylactic," which medium in the hands of the British administrators has proved a highly efficient instrument for combating the disease, and which has been the means of saving thousands of lives.

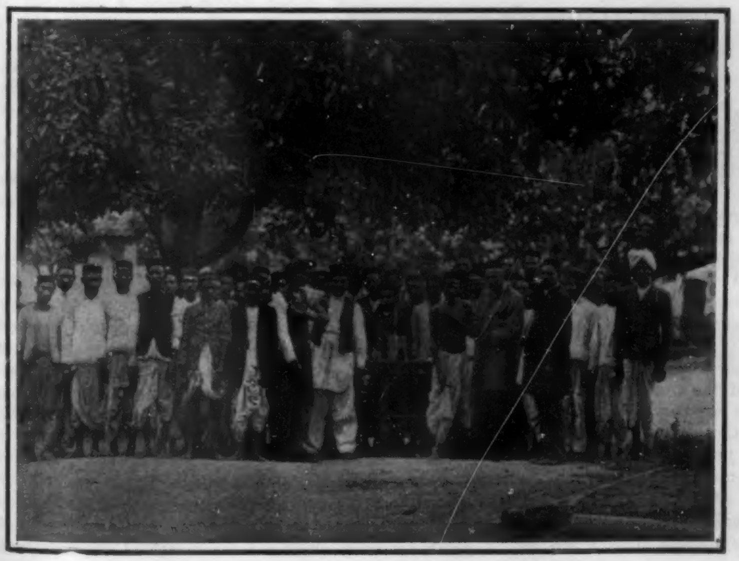
To-day the whole of Haffkine's vaccine required not only for India, but other countries throughout the East where plague is indigenous, is prepared at this laboratory. Through the courtesy of Capt. W. Glen Liston, M. D., D. P. H., a member of the Plague Research Commission, and the Acting Director of the Laboratory, we are enabled to describe and illustrate the preparation of this prophylactic agent. The vaccine may be succinctly called a culture of the plague bacillus, which after being grown in a suitable soil or broth for at least six weeks, is sterilized or killed, and to which is then added 0.5 per cent of carbolic acid. The preparation is then packed in small hermetically-sealed glass bottles or phials, each of which contains on the average 20 cubic centimeters of the material, a quantity sufficient for five full doses.

The medium in which the plague germs are cultivated is produced from goat's flesh or wheat flour, to which a certain proportion of hydrochloric acid is added. This mixture is stored in large water-jacketed jars maintained at a temperature of 158 deg. for three days. During this period the insoluble albumen of the flour or meat, under the action of the hydrochloric acid, is converted into the soluble albuminoid bodies known as peptones and propeptones. The acid liquid is then neutralized by the addition of caustic soda. Common salt is thus formed. This liquid is diluted, boiled, filtered, and decanted into large glass flasks corked with cotton wool. The flasks are passed into a large sterilizer, and subjected to saturated steam at a pressure of two atmospheres. The result of this process is the production of a clear, sterile, amber-colored liquid or broth, constituting the soil in which the plague germ is grown.

The plague germ itself is isolated either from the blood or the bubo of a patient suffering from the disease. It is first purified by cultivation in test tubes containing broth jelly formed by the addition of agar-agar to the liquid broth previously secured. At this juncture the germ is examined and tested, in order to identify it definitely as the plague bacillus. Among these tests, one of the most important is the characteristic appearance known as "Haffkine's stalactites," presented by the growth of the organism in suitably prepared broth. The plague bacillus thus isolated and identified is subjected to cultivation in a Pasteur flask for a period not exceeding fourteen days. The seed multiplies considerably, and small quantities of the material raised in this Pasteur flask are transferred to several larger flasks, each containing one liter of broth, this operation being carried out in the sowing and testing room.

As each flask receives its quantum of the plague organisms, it is removed to the adjacent incubating room. This is a large apartment in which the flasks are disposed in rows upon long tables extending longitudinally from one end of the room to the other. Some idea of the magnitude of the serum-preparing operations may be gathered from the illustration of this department, showing several hundred flasks under incubation. The flasks are left in semi-darkness for at least six weeks. During this period the germs multiply enormously. When it entered the incubating room the broth was perfectly clear, but upon withdrawal it is turbid, because of the vast increase in the number of plague bacilli.

It will be realized that in the preparation of this vaccine, it is imperative that the culture medium



Inoculating natives at a village assembly.

The Bombay bacteriological laboratory at Parel.

HOW INDIA IS FIGHTING THE PLAGUE—THE MANUFACTURE AND USE OF ANTI-PLAGUE VACCINE.

should propagate plague organisms solely. Consequently, upon the conclusion of the incubation period, the flasks are returned to the sowing and testing room. A small quantity of the contents of each flask is carefully withdrawn with aseptic precautions, and transferred to a broth jelly tube. In the course of from twenty-four to forty-eight hours, the germs grow upon the surface of this tube. In precisely the same manner as the farmer can recognize the nature of the crops on his land, so can the bacteriologist distinguish the appearances of his germs, and detect the presence of any other bacillus in addition to that of the plague. Should the appearance indicate that plague organisms alone are existent, the flask which has been so sampled is passed on to other departments for further manufacture and tests.

The next stage is the sterilization of the vaccine. The germs, which up to this point have been so carefully tended and cultivated, are killed. The flasks are immersed in water, and subjected to a temperature of 131 deg. F. for fifteen minutes. At the end of this period the material will be found absolutely sterile and containing no living organism. At the same time, however, it might be possible for some latent organism to develop and thrive in or enter the broth subsequently, in which event serious complications would result, as experience has strikingly demonstrated. Consequently, at this stage the vaccine undergoes what constitutes one of the most important phases in its production, and upon the fulfillment of which its purity and safety vitally depend. This is the addition of 0.5 per cent of carbolic acid to the broth, to render it an unsuitable soil for the growth of any germ.

After carbolization the serum is ready for bottling. The vessels in which it is sealed for distribution are of peculiar shape, as may be seen by reference to the illustration. By means of an air pump and other special apparatus, the bottles are vacuumized and hermetically sealed. They are then packed into iron boxes, which are placed in large ovens and submitted to a temperature of about 390 deg. F. for three and a half hours, which action kills any bacteria that may be lurking within the bottles. As it is withdrawn from the oven, each iron box or crate is immediately sealed, and the word "sterilized," together with the date, is imprinted on the exterior. The boxes are now ready for receiving the charges of the vaccine, and this work is carried out in the decanting room.

The charging of the bottles from the flasks of carbolized vaccine is a delicate operation, requiring great skill in order to prevent any possible chance of the vaccine coming into contact with the open air even for an instant.

The bottles after being filled are set on one side for a week, a sufficiently long period to permit of the multiplication of any germ that may have gained an entrance to the vaccine during decanting. The average number of bottles that can be charged from the contents or "brew" of each flask is forty-five, and each batch is preserved, so that in the event of a "brew" subsequently evidencing contamination, the bottles charged from that particular affected flask may be instantly ascertained and destroyed. Two bottles are selected from each "brew," and are subjected to searching tests carried out in two ways—aerobically and anaerobically. In the former tests, all those bacilli which require oxygen for their development are discovered, while the second process serves to reveal those organisms which can thrive only in the absence of oxygen, such as the tetanus bacillus. These tests proving satisfactory, the brew is pronounced fit for use, and is passed through the last stage of its manufacture. This is the securing of a small sample of each phial for retention in the laboratory. A small portion of the fluid is forced into the long neck of the phial. The neck is then heated in a blow-pipe flame near the shoulder of the bottle, melting the glass and separating the neck from the body of the phial, and at the same time hermetically sealing both the bottle and the neck simultaneously. Each sample carries a duplicate of the label and date on the body of the phial, while all the samples collected from a single "brew" are stored in a sheet of corrugated paper and preserved in the laboratory. Should, therefore, any suspicion regarding the condition of a phial when sent out arise, or complications attend inoculation, the laboratory can easily substantiate the sterility of the vaccine sent out by testing the sample, and moreover can ascertain whether the serum has been retained for too lengthy a period before being used. In this way not only is the public safeguarded, but the laboratory is protected against false charges.

Haffkine's serum being a dead prophylactic agent, it has to be injected beneath the skin and introduced into the blood stream of the patient by means of a syringe, unlike vaccination, where the living vaccine is simply placed upon an abrasion of the skin. The operators who are privileged to carry out the inoculation are specially trained in the methods of fulfilling the operation, and the vaccine is supplied only by the laboratory to those certified as competent for the work despite its simple character. There is thus no possibility of the vaccine falling into the hands of unskilled or unscrupulous persons. Should any calamity befall a patient from inoculation, the responsibility for the misadventure can be brought home, since the various hands through which that particular dose of vaccine passed can be traced and checked from the first stage of preparation to its application.

The vaccine thus prepared, if preserved in a cool dark place, will retain its full efficiency for a period of eighteen months, though of course it is expedient that it should be used as soon after being received as possible. After retention for eighteen months, however, the old vaccine should be destroyed.

The medical officers experience no little difficulty at times in securing the consent of the natives to inoculation. As a rule, the operators collect the influential leaders of the people, and secure their interest in the proposal. The advantages of inoculation are carefully explained, and they are urged to persuade their less educated tribesmen to consent to the ordeal. About one hundred people are thus possibly assembled, and those who volunteer to undergo the operation are duly inoculated before the community. The painlessness of the operation thus being demonstrated, many waverers will frequently follow the example of their friends, and in this manner a number of people may be inoculated at the one meeting.

Inoculation itself is simply and quickly carried out. The most convenient spot on the body is the back of the left upper arm about midway between the shoulder and the elbow. The skin is first well scrubbed with a five per cent of carbolic lotion, and is then puckered up between the thumb and fingers of the left hand, the needle being injected into the skin in a sloping direction more or less parallel with the surface, care being observed to avoid the big vessels and not penetrating the muscles, but at the same time entering the subcutaneous tissue. The dose is then slowly injected, the needle withdrawn, and a few pads of cotton wool dipped in the carbolic solution applied for a few minutes.

The symptoms of inoculation commence as a rule in from three to five hours, and consist chiefly of swelling and pain at the seat of inoculation, accompanied by a rise of temperature. As the pain becomes more acute by the movement of the affected part, it is advisable to give it a complete rest for about thirty-six hours. The fever generally lasts from twenty-four to thirty-six hours, but pain at the seat of inoculation generally prevails for three or four days. As, however, the vaccine acts differently on various people, a uniform reaction cannot be obtained, fever being almost absent in some cases; but the fact that there is an absence of reaction does not necessarily imply that the inoculation has not "taken," as would be said under similar circumstances after vaccination for small-pox. The doses range from 0.2 cubic centimeter for an infant to 4 cubic centimeters or a full dose for an adult.

Careful observations have been carried out to ascertain the efficacy of the anti-plague vaccine in decreasing the mortality arising from the disease. Although inoculation does not necessarily signify immunity from attack, yet as in small-pox vaccination it insures a lower proportion in mortality. For instance, in the Punjaub, out of 49,433 cases of plague among 639,630 uninoculated persons, 29,723 cases proved fatal—a case mortality of 60.1 per cent. In the same area there were 186,797 members of the population who had undergone inoculation. Out of this number, 3,399 fell victims to the plague, but the mortality was only 814, representing a case mortality of 23.9 per cent. In other districts even more striking results have been obtained, the sum of which conclusively proves that in this prophylactic agent the authorities have an efficient scientific instrument for reducing the effects of the scourge. In addition to supplying the whole of the country with the necessary vaccine, the Bombay Bacteriological Laboratory prepares supplies for the medical officers in other parts of the world where the epidemic is rampant; and it speaks volumes for the care and skill with which the agent is prepared, that since the above-described processes of manufacture have been adopted, and the many precautions enforced to insure absolute sterility of the vaccine, out of the thousands of phials that have been distributed, not one single instance of contaminated vaccine has been discovered. The institution, moreover, performs other highly valuable offices in connection with the bacteriological treatment of disease and plague research, and it was here that the epoch-making discoveries in connection with the etiology of plague were made by a commission working on the facts and materials which had been accumulated after ten years of patient labor on the part of the staff of the laboratory.

An authority states that the best test for cylinder oils is to heat them in a current of air for one hour at the temperature corresponding to the steam pressure at which they are to work. The loss in weight should not exceed 0.5 per cent.

Correspondence.

THE MYSTERIOUS AEROLITE.

To the Editor of the Scientific American:

In your issue of November 7, 1908, under the heading "Was This an Aerolite?" Mr. Park Marshall, of Nashville, Tenn., writes a very interesting account of what he believes to have been a meteor. He declares that from his position the crash of the impact was as a great explosion of dynamite accompanied by a slight vibration of the earth, and that it was audible throughout several counties, including Franklin, Coffee, Warren, and Grundy, of Tennessee.

He adds that "so great was the interest and excitement created by this aerial disturbance, that citizens telegraphed to and fro from town to town seeking information, and that it is the chief subject of query and discourse to this day at the places mentioned."

I find that on September 8, at about 10 A. M. (which he mentions as the exact date and time in his correspondence to have been the hour in which that section was so terrified by this "aerial disturbance") a shipment of dynamite was exploded at Wartrace, Tenn., on the N. C. & St. L. Railway.

As the writer states that he was at Estill, Tenn., at the time, which is only a very short distance from the scene of the explosion, may I with apologies suggest that it was this explosion which your correspondent, Mr. Park Marshall, heard? E. B. Hoyte.

Nashville, Tenn., November 14, 1908.

A $500 Prize for a Simple Explanation of the Fourth Dimension.

A friend of the Scientific American, who desires to remain unknown, has paid into the hands of the publishers the sum of $500, which is to be awarded as a prize for the best popular explanation of the Fourth Dimension, the object being to set forth in an essay the meaning of the term so that the ordinary lay reader can understand it.

Competitors for the prize must comply with the conditions set forth in the Scientific American of November 21, 1908.

Oliver Weldon Barnes.

Oliver Weldon Barnes, a well-known old-time civil engineer, died on November 17, still active in his profession up to the last, despite his advanced age.

Mr. Barnes in 1847 joined the pioneer surveying corps of the western division of the Pennsylvania Railroad. He made the final location of the daring lines which then distinguished that division.

Mr. Barnes in the course of his career was in charge of the engineering for many railroads, including the Boston, Hartford & Erie.

The Current Supplement.

The current Supplement, No. 1717, opens with a plea by Frederic A. Lucas for the preservation of the fast-disappearing whale. Prof. P. Gruner gives a historical review of theories of electricity. S. E. Brown tells how the Paris telephone switchboard, recently destroyed by fire, was rebuilt by an American firm in record-breaking time. The construction of the German automatic stamp-vending machine is described in detail. Stanley C. Bailey discusses the question whether precious stones can be manufactured. The manufacture of catgut for surgery is described at length. Dr. Gustav Glock propounds a theory of the ascent of sap in plants. The Kuch quartz mercury lamp is described by O. Bechstein. The Scientific American's English correspondent writes on a 325-horse-power kerosene motor for use in Italian submarine boats. The Cowper-Coles process of making copper tubes, sheets, and wire direct is explained. Prof. J. C. Kapteyn presents a very striking picture of the motion of our solar system through space. The usual notes are also published.

A New Method of Electric Welding.

L. S. Lachman has devised a new process of electric welding which makes it possible to employ steel instead of malleable iron in the manufacture of numerous articles. As two pieces of metal of unequal sections cannot be welded together satisfactorily Lachman has one piece cast with a projecting edge and the other with a point. The two projections, forced together by a hydraulic press, are included in an electric circuit, of which they form the segment of highest resistance. Hence, when a strong current is caused to flow through them, they are heated nearly or quite to the melting point and, being subjected to great pressure, quickly become welded together, and attach themselves to each other more firmly than they could be attached by means of rivets, because there is no break in the continuity of the metal.

Acid-resisting Cement.—A recent issue of the Brass World gives the following formula for an acid-resisting cement, for tanks, floors, etc.: Silicate of soda (water glass), 6 parts; glycerine, 1 part; red lead, 3½ parts; fine cinders, 10 parts. The silicate of soda and glycerine are mixed and then the red lead and cinders added to make a mass resembling putty. This cement soon sets or hardens, and when heated to the temperature of boiling water, unites with brick or Portland cement to form a strong joint.

THE HEAVENS IN DECEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

Morehouse's comet, for the last two months the most noteworthy object calling for our attention, is by this time so low in the west at sunset that it can no longer be well observed.

We may turn our attention in another direction, and consider some results recently published by Prof. Lowell, concerning the atmospheres of the major planets.

No substance is perfectly transparent; but all known bodies absorb the light which passes through them, to a greater and greater extent as their thickness increases. For most transparent materials, this absorption is general; i. e., it affects light of different colors (or wave lengths) very much in the same way. But some substances show a selective absorption for light of particular wave lengths; that is, they absorb this light strongly, while letting through that of closely neighboring wave length almost undiminished.

All hot gases act in this way; for example, the sun's atmosphere absorbs light of the same wave lengths it emits, producing the familiar Fraunhofer lines of the spectrum. But some cold gases, though emitting no light, show a similar absorption. Among these are oxygen and water vapor, which are responsible for many lines in the solar spectrum as we see it.

That the absorbing medium is in *our* atmosphere and not in the sun's, is proved by the fact that these lines increase in strength as the sun sinks lower toward setting; that is, as the thickness of air through which we look increases. The water-vapor lines, too, change with the varying humidity of the air.

Almost all the lines in question are at the red end of the spectrum, and for this reason have been very difficult to observe in the spectra of other bodies than the sun; for the extreme red is very faint to the eye, and wholly without effect on ordinary photographic plates.

But the workers at the Lowell Observatory, using the new red-sensitive plates and making long exposures, have succeeded in obtaining photographs of planetary spectra, which in the case of Jupiter and Saturn at least, extend as far into the red as eye observations could possibly go under any circumstances.

The results are of great interest. For all four of the outer planets the lines due to atmospheric oxygen are stronger than for the moon (used for comparison to show the influence of our own atmosphere). We may hence conclude that their atmospheres contain oxygen. Similarly, in the case of Uranus and Neptune, there is reason to believe that hydrogen, and perhaps helium, are present in their atmospheres. But in all four cases, the strongest bands in all the spectrum are those, far out in the red, due to water vapor, which are very much heavier than those produced by one atmosphere alone. So it appears that the vapor of water is a principal constituent of their atmospheres. In our own it is present only in a small percentage; but this would be greatly increased by a moderate rise in temperature, which would increase evaporation from the ocean. If the earth's surface temperature should in any way be raised above 212 deg. F., the oceans would begin to boil, and we would soon have an atmosphere composed mainly of water vapor, which in this case we would call *steam*.

We are thus led to believe that the outer planets are hotter than the earth. This has long been suspected, in the case of Jupiter, on account of the very rapid changes of the cloud-like markings upon his surface; but this new evidence, applying to all four planets, is still stronger. How hot they are, we cannot of course estimate; but it looks very likely that these planets consist of a nucleus hot right up to its surface, veiled in dense, unbroken clouds, floating in an atmosphere largely composed of steam.

THE HEAVENS.

Studying our map, we see that the winter constellations are now fairly in sight. Orion is well up in the southeast, with Aldebaran above him, and Sirius flashing and twinkling below.

Due east, and to the left of these constellations, are Auriga (with the great yellow star Capella), Gemini, and lowest down Procyon in Canis Minor.

Perseus, Andromeda, and Aries are almost overhead. Pisces, Cetus, and Eridanus fill a very large and dull region in the southern sky. The bright star low in the southwest is Fomalhaut. The one above it, not shown on the map, is the planet Saturn.

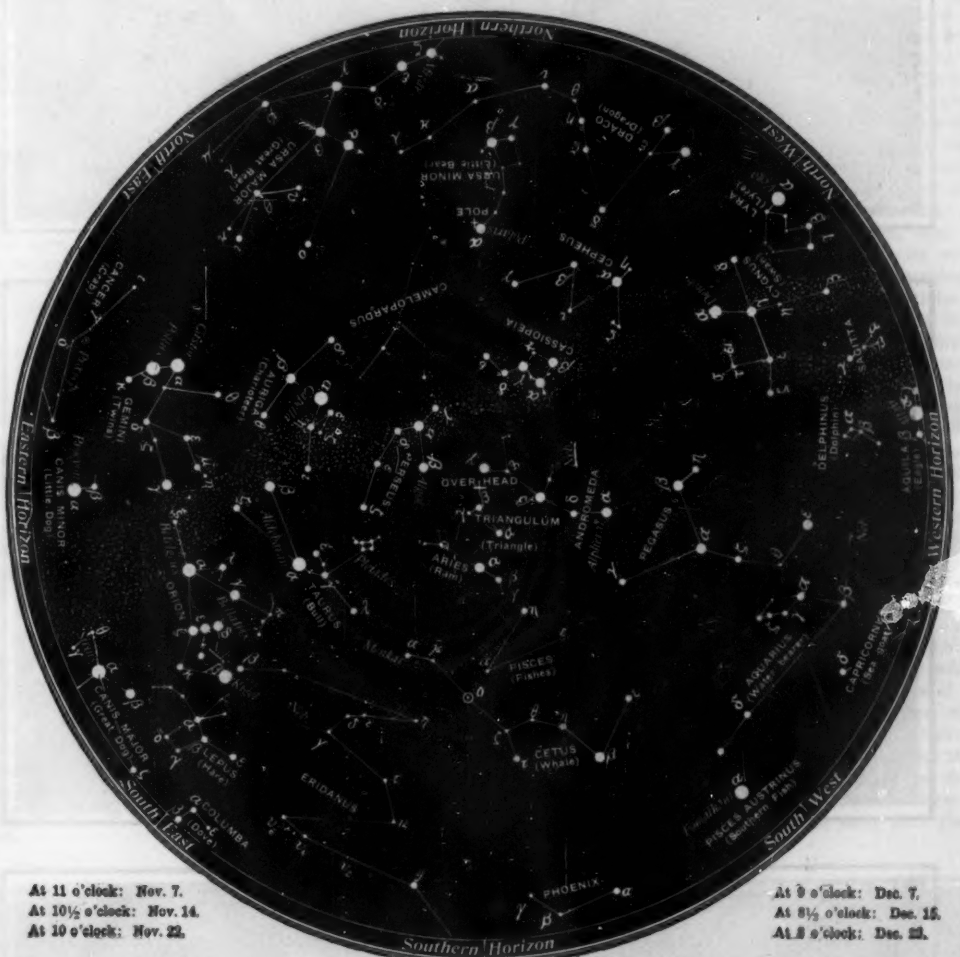
The great square of Pegasus is high up, west of the zenith. Far below, just on the horizon, Altair is setting. Vega is likewise very low, almost due northwest, with Cygnus above.

Cassiopeia and Cepheus are above the Pole, Ursa Minor and Draco below, and Ursa Major lower still, east of north.

THE PLANETS.

Mercury is morning star till the 23d, and afterward evening star, but is too near the sun all through the month to be well seen.

Venus is morning star in Libra and Scorpio, and rises about 4:40 A. M. in the middle of the month.



At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 22.

At 9½ o'clock: November 30.

NIGHT SKY: NOVEMBER AND DECEMBER

Mars is likewise morning star, very near Venus at the beginning of December; but as his eastward motion is much slower than hers, she draws away from him, and is about 20 deg. distant at its close.

Jupiter is in quadrature with the sun on the 5th, rises about 11:30 P. M., and crosses the meridian at 6 A. M.

Saturn is also in quadrature, on the 25th, but, being east of the sun instead of west, crosses the meridian at 6 P. M. and is visible all the evening.

Uranus is approaching conjunction with the sun, and is unobservable. Neptune is nearing opposition, and can be observed after 10 P. M. or thereabout.

THE MOON.

Full moon occurs at 5 P. M. on December 7, last quarter at 4 P. M. on the 15th, new moon at 7 A. M. on the 23d, and first quarter at 1 A. M. on the 30th.

The moon is nearest us on the 26th, and farthest away on the 14th. She is in conjunction with Saturn on the 2d, Neptune on the 10th, Jupiter on the 14th, Mars on the 19th, Venus on the 20th, Mercury on the 23d, Uranus on the 24th, and with Saturn again on the 29th.

At 1 A. M. on the 22d the sun reaches its greatest southern declination, and in the language of the almanac "winter commences."

ECLIPSES.

There is an eclipse of the sun this month, and there comes very near being one of the moon.

The former, which takes place on the 23d, is visible only in the southern hemisphere. The track of central eclipse crosses South America, about 30 deg. below the equator, passing a little north of Buenos Ayres. A large partial eclipse will be visible in the morning all through Argentina, Chile, and southern Brazil. The rest of the shadow track is all over the ocean, passing about 1,000 miles south of the Cape of Good Hope, so that a partial eclipse will be visible in South Africa.

At the time of full moon on December 7, the moon just grazes the earth's shadow. If it was a few miles farther north, it would enter the shadow, and there would be a small partial eclipse. As it is, we may be interested, if we watch the moon rise that evening, in knowing that it is as nearly full as the moon can possibly be without getting into the shadow of the earth.

Princeton University, Observatory.

Electro-acoustic Method of Measuring Distances at Sea.

Debrix has invented an ingenious method of measuring the distance of a vessel which cannot be seen, because of darkness, fog, or intervening objects. The method is based on the difference between the velocities of sound and Hertzian waves.

At the receiving station, which we may suppose to be a lighthouse or semaphore station on the coast, a train of clockwork causes a pointer to move over a divided dial at the rate of one division per second. The clockwork is started by a Hertzian wave, which is sent out by the ship simultaneously with a sound wave, produced by a gun, siren, or whistle. As the propagation of Hertzian waves is practically instantaneous, the pointer may be regarded as starting at the instant at which the sound wave leaves the ship. The observer on shore watches the pointer and notes its position at the moment the sound reaches his ears. The distance of the ship is then obtained by multiplying the number of divisions traversed by the pointer by the velocity of sound (about 1,100 feet per second).

The position of the ship can be determined with greater precision if the Hertzian and auditory signals are received by two shore stations, which can communicate with each other by telegraph. The distance of the ship from each station having been found, the ship's position on the chart will be at the intersection of two circular arcs drawn about the stations, as centers, with radii equal to the two distances. The result might be communicated to the ship by wireless telegraphy.

A still better plan would be for each of the chain of coast stations to emit, at regular intervals, simultaneous Hertzian and auditory signals (the stations being distinguished by peculiarities in the signals, as lighthouses are now differentiated). Then any ship provided with the simple receiving apparatus described above could determine its position at any time and make its way safely to port.—Cosmos.

A motor-operated revolving door has recently been installed in a Boston store, which differs materially from the ordinary type. The door is 10 feet in diameter, and is fitted with six wings, which are so arranged that if they come in contact with any person, they will swing back out of the way. The doors will swing in either direction, so that in case of a panic the crowd can pass out at either side, the doors folding before them. A quarter horse-power motor drives the door at a speed of about six revolutions per minute. After a wing has been swung out of its normal position, it returns under the action of the spring, but its motion is controlled by an air check.

AN AUTOMOBILE HOE.

BY JACQUES BOYER.

An automobile hoe, or cultivator, represents a recent application of automobilism to light agricultural machinery. The new implement, which is designed especially for the cultivation of beets and other crops planted in rows, has six blades and is driven by an explosion motor, by means of gearing. The chassis, constructed of steel angle bars, is pointed in front and rests on four wheels, of which the front pair serves for steering and the hind pair for driving. In the front of the machine is a two-cylinder, four-cycle motor of 10 or 12 horse-power, which may be adapted to burn either carbureted alcohol or gasoline by an easily effected change in the carbureter. The feed and escape valves may be controlled by hand, and the ignition is furnished by accumulators, an induction coil and electric bougies. The bearings are continuously lubricated by a mechanical device. The cylinders are cooled by water, which is continuously pumped through a radiator of the wing type, which is shown very clearly in one of the photographs (Fig. 2). On the axis of the flywheel and almost surrounded by its rim is a conical friction clutch, so constructed as to exert no lateral pressure on the collars. This clutch is connected by an elastic sleeve with the speed changing box, which contains two trains of gearing, one for forward, the other for backward motion, the latter effecting a reduction of speed in the ratio of 1 to 3. The differential is controlled by an endless screw. The maximum speed of the machine is about 2 feet per second or a mile and a quarter per hour. Because of the reduction mentioned above the speed backward cannot exceed 8 inches per second. The driver sits in the center of the machine and steers by means of a Galle chain connected with the front pair of wheels. But the apparatus is so arranged that the position of the operator may be varied to suit the requirements of the work. In some cases he walks behind the machine, where he can watch the hoes and regulate the speed accordingly. On reaching the end of the row the machine turns on one of its driving wheels as on a pivot, and that wheel returns along the track made by it in coming. This maneuver, which is illustrated in one of the photographs (Fig. 2) is easily effected by means of the differential.

The automobile hoe complete weighs 2,750 pounds, and cultivates a strip more than 8 feet in width. Over horse hoes it possesses the advantage of suppressing the trampling of the young plants, in addition to greater uniformity of action. Hence it will, doubtless, be generally employed wherever drilled crops are cultivated on a large scale. By the substitution of blades of special form the machine can be adapted to accomplish, rapidly and neatly, the preparation of the ground before sowing, which is so important, especially in the cultivation of beets.

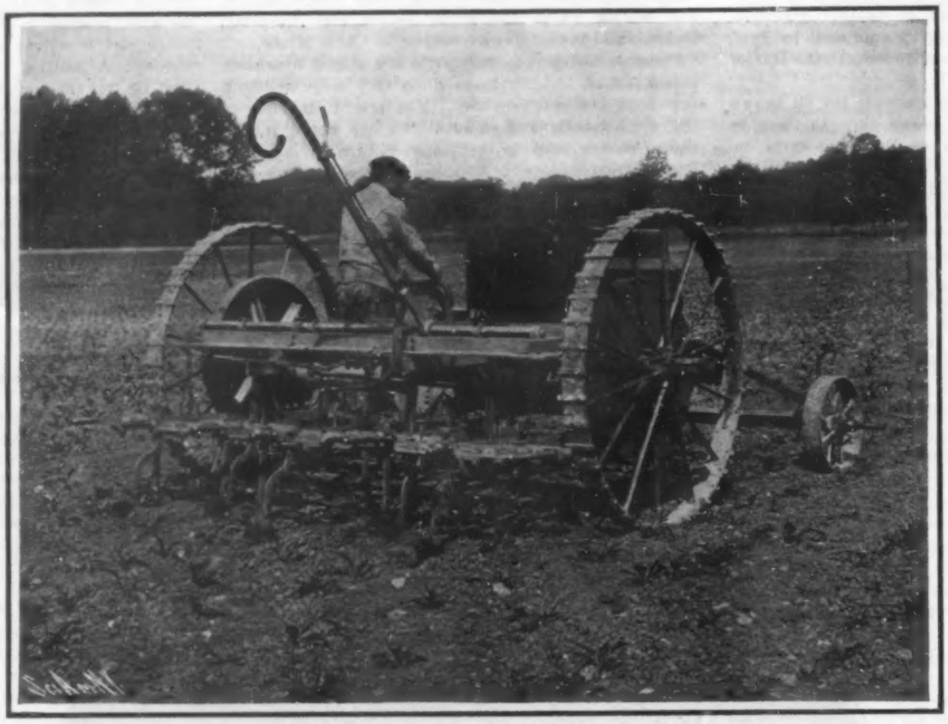


Fig. 1.—The automobile hoe in operation.

Fig. 2.—The automobile hoe turning.

Fig. 3.—The automobile hoe with bonnet removed to show mechanism.

AN AUTOMOBILE HOE.

Electric Cleansing Compound.—Spot removing preparation. To 500 parts of water add 30 parts of glycerine, 7 parts of the strongest caustic ammonia, and 30 parts of ether, mix all thoroughly, then add 500 parts of water and 30 parts of white olive oil soap, shaking thoroughly until everything is dissolved.

Optical Properties of Colloidal Solutions of Gold.

The study of the remarkable phenomena exhibited by the colors of colloidal solutions of gold was commenced, and pursued with some success, by Faraday, but no further progress was made until the recent invention of the ultramicroscope made it possible to prove the absolute uniformity of the particles of gold in a given solution.

W. Steubing has indicated a new method of investigation, by which the quantity of light diffracted laterally by the colloidal solution can be measured. He begins by preparing a number of gold solutions of each of the characteristic colors (blue, red and violet) in such a manner that the solutions are very permanent, pure in tint and as much alike (for any one color) as possible. These solutions are first examined with the ultramicroscope for the purpose of determining the color, luminosity and size of their particles. Two series of observations with the spectrum photometer follow. In the first series the absorption of various rays of the solutions (suitably diluted) is measured; in the second series the color and intensity of the light diffracted by the solutions are determined. The polarization of the light is next studied with the ultramicroscope in combination with a Babinet compensator. A second very careful examination with the ultramicroscope alone is then made, for the purpose of making sure that no change has taken place in the solutions. Finally, the quantity of gold is measured by two electrolytic methods.

In general, it was found that most the incident light was absorbed by the particles of gold and only a small fraction was diffracted. It was shown also that the color phenomena could not be explained by resonance. The lateral radiation from red solutions (containing green particles) was maximum for wave lengths between 560 and 570$\mu\mu$. In blue solutions (containing reddish yellow particles) a weak maximum was found at 570$\mu\mu$ and a stronger maximum in the red. The violet solution (containing both green and reddish yellow particles) is equivalent to a mixture of the red and blue solutions. The dull green solution (containing yellowish particles) exhibited a feeble luminosity with no well-marked maximum.

The curve of absorption of colloidal gold does not coincide with that of massive gold. The red solutions showed a well-marked maximum of absorption at 525 to 530$\mu\mu$. The blue solutions showed a minimum absorption at 490$\mu\mu$ and an ill-defined maximum in the yellow, orange, or red. The absorption of the grayish green solution was almost uniform throughout the spectrum. The diffracted light was found to be partially polarized, the maximum polarization occurring with a deviation of 90

deg. The ultramicroscopic examination of the red and blue solutions by polarized light revealed considerable differences in the form of the particles. With the red solution the diffraction disks were always circular, but with the blue solution they were often curiously deformed. In general, the phenomena exhibited by the blue solutions were far less uniform than those of the red solutions.

THE GUIDING LIGHTS OF OUR COASTS.

BY C. H. CLAUDY.

The goal toward which the Lighthouse Board of this country is striving, is a continuous chain of lights, completely encircling the United States and possessions, and, in the case of rivers and inland seas, bounding the waters on all sides, so that a ship may never leave the area of light thrown by one lighthouse, before entering the circle of light of another. As fast as Congress will appropriate the money, the gaps are being filled.

But what makes the light? When the curious inquirer is told "kerosene," he naturally wonders why his own student lamp does not give a better one, if the same oil in the lighthouse sends its beam from five to twenty-five miles.

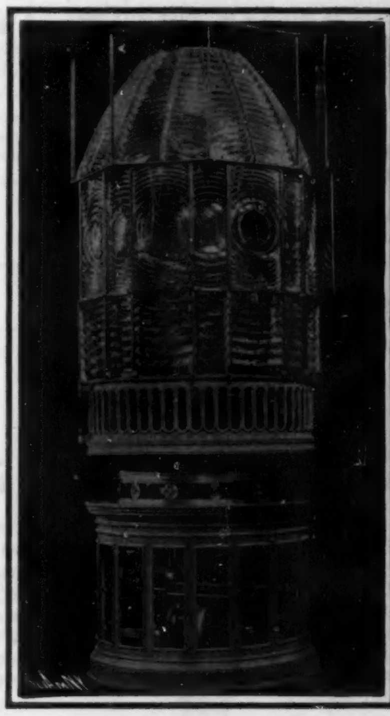
Various methods of lighting were in use until 1840, when a new system was introduced of employing nearly true paraboloid reflectors and better glass lenses. In some cases these reflectors gave a light which is not surpassed even to-day, except when handled with intelligent care. In 1852, when the present Lighthouse Board was instituted, the Fresnel system of lenticular glasses was introduced from France, and still remains. The first cost is great, but by the saving in oil over the reflector system this is soon reduced. With any reasonable care, a fine light always results; and it is impossible for a keeper to maintain a poor light with this apparatus without flagrant disobedience of instructions.

The accompanying illustration shows a first-order lenticular apparatus. It gives a flash every four seconds, alternate flashes being of slightly different duration. It will be seen that there are more or less complete lenses in the center of the apparatus, surrounded by more or less complete rings of prisms. Above and below are other sets of prisms, which catch the spreading rays of the central light and send it out straight toward the horizon.

Even with such an apparatus, no common lamp can supply the light. First-order lamps have five wicks, one inside the other, and are fed with oil by a pump and pipe system. The oil is fed to the wicks so that it reaches the ends, where the flame is, in the right time and in the right quantity. It is difficult to look at it, so intense is the light. In the lenses rather than in the lamp is the secret, for they pick up and utilize nearly all the rays of light which ordinarily go astray. The Fresnel apparatus collects almost all of this waste light, and reflects and refracts it out in one great broad beam of light, parallel to the surface of the sea, where it is needed.

A diagram is reproduced with this article, showing the relative range of lights of the different orders and the relative intensities of a flash and a steady beam. All the light available is concentrated into the flash. In the steady beam, which has no intervals in it, the light covers a broader space, and so cannot cover it so far. That is one reason for making most first-order lights, which are to be seen at a great distance, very high, when they are fixed, and flashing whenever possible, so as not to interfere with near and similar lights.

The flames which come from the lamps are largely transparent. So, of course, are all other similar flames. If flames were not transparent, there could be no advantage in having one flame inside another, and a third inside the first two, etc. The lights from the inner ones could not get out, and would do no good. Pictured with this article are flames of a first-order and a third-order lantern, to illustrate the transparency of the flames. These photographs were taken in a fraction of a second, and developed with great care, so as not to block up the delicate tracery of detail. As it is, the reproduction necessarily loses much of the fineness of the original.



First-order revolving Fresnel lamp.

First order flame.

Third-order flame.

The irregularity of the flames is of less importance than the maintaining of a solid band of flame across the focal plane of the system, which is shown in the larger flame photograph, by black lines. It is from this point that the lenses take the light which they project out to the horizon, this part of the flame being the brightest and the steadiest. The relation of lamp and lens system is carefully adjusted, until all the light from the flame in the focal plane of the system is being sent to the place where it is most needed.

In some lighthouses, usually for range light purposes, the light is all to be concentrated in one beam. This is done by concentric rings of prisms and a central bull's eye and a reflector. Vessels getting such a light in range, either by itself or with another light, and running down the beam, are safe from obstructions which may be nearby the range lights, or beams of light, marking out the channel to be followed.

It is frequently asked of light keepers, why electricity is not used in place of mineral oil. An electric light is expensive to install, and difficult and expensive to maintain. There is always difficulty in keeping the arc exactly in the focal point of the lenses, the carbons never burning twice alike, and constant watching being necessary. Failure to have the light source exactly in the focal point of the lens results in sending the light rays up or down instead of straight out where they are wanted. Electricity, while superior in penetrative power in a fog, has no advantage over a powerful oil lantern in clear weather. Mineral oil, colza oil, or lard oil lights of the first order could be seen a hundred miles were it not for the curvature of the earth; and as long as the light is visible long before the coast is, all purposes are served.

It is only within recent years that mineral oil has been in use. Lard oil succeeded colza oil, and was used exclusively up to 1880, and with mineral oil up to 1889. Since the latter year, mineral oil has been used entirely, except where electricity has been experimented with, or coal or acetylene gas. So far, coal oil, for power, efficiency, cleanliness, ease of operation, and cheapness, holds its own against all other means of light making.

Electricity, if it can be successfully installed, is the best light; but through expense of maintenance, and in the inability to get skilled attendants for such a light for the price the law sets on keepers' services, it makes slow headway. The Lighthouse Board, however, keeps fully informed as to all improvements in such apparatus, and is anxious to experiment further whenever Congress will provide the funds.

The traveler who cruises up the coasts, and who sinks one light before picking up another, may know that somewhere in the dark circle is a spot picked for the foundation of a light which will be erected as soon as funds and time allow.

It is reported that from 2,500 to 3,000 tons of electrolytic copper will be required for the electrification of 1,310 miles of railroad in Sweden, the conversion of which from steam to electricity has been decided upon. The lines concerned are all to the north of Stockholm except the Charlottenburg and Laxa and the Gothenburg and Stramstad lines. The system will be fed from five power stations, and work will be commenced early next year.

Diagram showing relative intensities of lights of different orders and different characters.

THE GUIDING LIGHTS OF OUR COASTS.

Handy Man's Workshop

The Editor of Handy Man's Workshop will be glad to receive any hints for this department and pay for them if available.

Suggestions for Christmas.

The Christmas Tree.

A REVOLVING CHRISTMAS TREE.

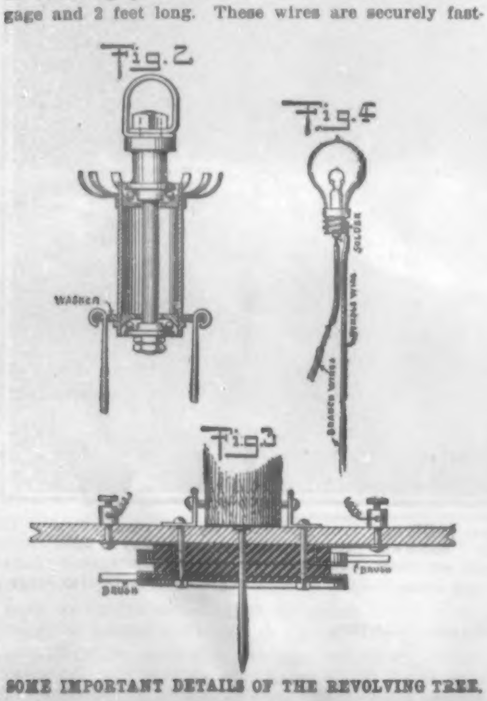
BY J. A. BERGSTROM.

There is nothing more impressive at Christmas time than a revolving Christmas tree, lighted by electric lamps. The following illustrates a simple yet inexpensive way of arranging a revolving Christmas tree, that will not upset and is easy to put up and take down year after year. The initial cost is the only one except the recharging of the batteries every year, which can be done from an ordinary lamp socket, using a number of lamps as a rheostat.

THE MOTOR MECHANISM AND WIRING OF THE REVOLVING TREE.

First locate in the ceiling, at the selected place for the tree, a beam or lath, and with the point of a sharp knife cut out a V in the ceiling paper, and bend the point of the paper to one side. Into this exposed part of the ceiling screw a hook about 3/16 inch in diameter. To this the tree is hung as hereinafter described. When the tree is taken down and the hook unscrewed, the V-shaped piece of paper may be pasted back to cover the hole and leave no marks in the ceiling.

The inside or stationary part of an old bicycle pedal is fastened to the above-mentioned hook. To the outer or revolving part are secured two wires about 12 gage and 2 feet long. These wires are securely fastened on opposite sides of the tree, preferably bent under a branch (Fig. 1). A piece of tin may be cut and fastened at the top of the pedal, from which the tinsel and strings of glass balls may be hung.



SOME IMPORTANT DETAILS OF THE REVOLVING TREE.

To the lower part of the tree is secured an arrangement as shown in Fig. 3. This consists of a large grooved pulley about 12 inches in diameter by $\frac{7}{8}$ inch thick, made out of ordinary pine board. The groove may be made with the edge of a half-round rasp. To the upper side of this pulley are secured three or more small brackets, which are fastened to the tree with wood screws. On the under side of this pulley are secured and insulated from each other two metal disks or rings, such as brackets for ordinary gas globes, terminating on top of the pulley with binding posts. Into the center is driven a tenpenny wire nail. A small box placed on its side may be put on the floor under the tree with a small hole to receive the nail. This forms a guide for the lower end of the tree. The box may either be nailed or weighted down, so as to keep the tree steady. Fastened on the box and insulated from each other are two copper brushes, one for each ring respectively. A small electric motor, such as is usually sold for $1, is now placed about 18 to 24 inches from the large pulley. As a rule, these motors run too fast for this purpose. A wire may be coiled about the motor shaft and soldered fast to form a worm which may mesh with a train of clock wheels. These can be obtained from any watchmaker. To the shaft of one of these wheels a small pulley is secured about 1 inch in diameter (Fig. 1). Wrap this pulley with cord, and put some rosin on, so as to increase the friction. Now place a small endless cord over the large and small grooved pulleys. The motor should be connected up with a dry-cell battery, and by placing in the circuit a switch or push button, the motor may be started at will.

AN ELECTRIC CANDLE.

The tree is now ready to revolve, and should make five to seven revolutions per minute. The batteries may either be kept in the box under the tree or in the cellar, where they will be out of the way. Two small holes may be drilled in the floor, about 2 inches apart. A pointed copper wire about 8 gage may be pushed through the rug or carpet into these holes and connections made to these wires with the batteries in the cellar and to the brushes on the top of the box, and by putting a switch in the circuit the current may be turned on or off.

From the binding posts on top of the large pulley, the feed wires are run on opposite sides of the trunk of the tree to their respective lamps; ordinary bell wire will answer the purpose. I have found it best to run several of these feed wires, and to put about five lamps on each set. This gives far better and more uniform distribution of the electricity to the lamps than when large wires are used, as the top lamps get very little or no current. The lamps used in series from the ordinary current are by far too bright, as it simply puts the tree in the "shade." A soft light is the more desirable, and the tree may be decorated to a better advantage with battery lamps, as no unsightly sockets or heavy cords are used, and there is no danger of fire. The wires are soldered on the lamps, as shown in Fig. 4, and may be placed in the hands of the images used in decoration of the tree. The lamps may also be inclosed in small Japanese lanterns, which will greatly add to the beauty of the tree.

Another pretty effect may be obtained by using an ordinary tree candle with its usual holder hung on a bough. To do this, remove the wick by boring a small hole in the center of the candle, into which insert the wires, already soldered onto the lamp, letting the lamp rest on the top of the candle (Fig. 5). Of course, the more lamps used, the prettier the effect. A 7-foot tree will require from 25 to 35 lamps.

The connection between the lamp and the feed wires may be done by twisting the ends together. Care should be taken that the ends of the opposite wires do not touch each other, and that no tinsel comes in contact with them. Run the branch wires on top of the branches. A diagram of the wiring is shown in Fig. 1.

When all the lights are turned on, start up the motor and see that everything is all right and that all the lamps are burning bright before decorating the tree. Then the lamps may be moved to suit the ornaments.

The box under the tree as well as the motor may now be covered up with cotton batting and small twigs cut from the lower branches of the tree.

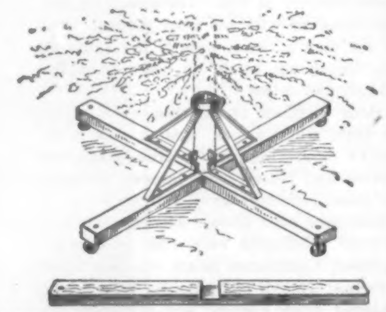
Instead of placing the tree in front of a window, it may be placed in the center of a dining-room table. The table may be opened about six inches to let the trunk of the tree pass through. Some of the lower branches will have to be cut off. The chandelier may be removed and a small hook screwed on the gas pipe, from which the tree may be suspended. To close the opening in the table, two tablecloths must be used, and a few twigs may be placed where the cloths meet.

A double floor switch may be employed, to one side of which the wires from the motor and to the other the wires to the lights may be connected. By manipulating the switch with the foot, the motor may be started or the lights turned on independently of each other.

ROLLER MOUNTING FOR THE CHRISTMAS TREE.

BY GEORGE W. NAYLOR.

Christmas trees are usually placed in a corner of the room, and this is often the cause of an upset when decorating parts that are adjacent to the walls and difficult of access. It has been the writer's practice to mount the tree on castors, so that it can be trimmed and lighted in the center of the room away from curtains and draperies and, when ready, moved into the corner or any other desirable location. The tree stand is broad, and the castors cause it to slide across the floor rather than upset, when the branches are bent in reaching the presents or decorations.


ROLLER MOUNTING FOR THE CHRISTMAS TREE.

The stand consists of two 3-foot lengths of 2 x 3-inch scantling, halved and joined together at their centers. An ordinary castor is fitted to each arm of the stand. The tree is mounted in a holder of strap iron consisting of a ring to which four arms are riveted or secured with stove bolts, as shown in the sketch.

FOLDING TREE STAND.

BY A. V. SEARING, JR.

The accompanying cut shows a simple way to make a support for a Christmas tree. The material should be of hard or tough wood that will not split easily.

Make three pieces like *A*, of $\frac{7}{8}$ x 2-inch strip, also three pieces like *C*, of $\frac{7}{8}$ x $2\frac{5}{8}$-inch strip, and one piece like *B*; for this the bottom of a peach basket will do very well. In the center of the disk *B* bore a 2-inch hole to receive the sharpened base of the tree. Fasten the *C* pieces to the underside of the disk *B* with screws. Bore holes in the arms of each *C* piece to just receive a 3-inch wire nail. In the top of each leg, *A*, as shown, insert a small nail or screw to form a point that will press into the tree. Now place a leg *A* in the slot sawed out of *C*, and pass a 3-inch wire nail through the holes.

When the Christmas tree is taken down the legs may be unhinged and the stand folded and packed away for use next year.

FOLDING TREE STAND.

TO PREVENT THE CHRISTMAS TREE FROM UPSETTING.

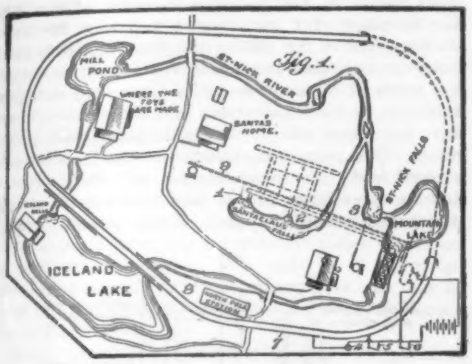
BY H. G. L.

The Christmas tree can be safely supported by the use of fine, almost invisible, wire. Fasten three or four wires to the main body of the tree at a point near the top. Draw each wire tight, and secure to brads in the door and window frames, or the picture molding, at opposite sides of the room. Twist one or two of the wires about strong limbs to prevent the tree from turning. This arrangement obviates all necessity for marring the floor.

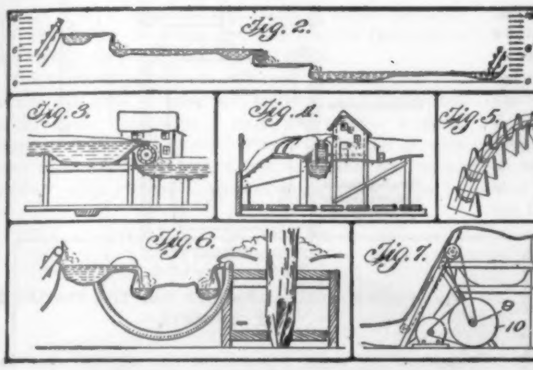
A CHRISTMAS TREE GARDEN.

BY L. GESSFORD HANDY.

A "garden" under the Christmas tree offers an excellent opportunity to add much to the interest of the children's holiday. In the accompanying illustrations I have shown how an interesting and instructive



PLAN VIEW OF THE GARDEN.



SOME SPECIAL FEATURES OF THE GARDEN.

garden may be made at small expense. The formation of rivers, lakes, falls, etc., is here prettily demonstrated.

A base 8 feet long by 6 feet wide (these measurements may of course be modified) supports the garden. This base is made of board ½ inch thick and with cross cleats to stiffen it. The boards are 3 inches wide and spaced ½ inch apart, to allow water that may leak from the garden to pass through to an oil or rubber cloth spread on the floor. The socket for the tree is quite substantial. It is built up, as shown in Figs. 1 and 6, of 1-inch boards, and screwed firmly to the base. The opening for the tree is 3½ inches across, and wedges are used when necessary.

The stream is supplied by water from the falls 1, 2, and 3, and flows around back of the tree to the mill pond, over the wheel, under the long bridge, and over the falls into the lake. It passes thence under the short bridge to a "bucket elevator." The water is here raised to the "mountain lake," to again supply the falls 1, 2, and 3. The "lift" could more properly be hidden from view, but is really interesting to look upon.

In Fig. 2 is illustrated a profile of the stream, falls, etc., showing the various levels to be observed. Fig. 1 is a plan view of the garden, showing the relative positions of the various devices and necessary wiring for operating them.

All curves in the railroad system are on a 20-inch radius. The engine and cars used are home made, and tracks are 1¼-inch gage. (These may be bought in the market if desired, but the store trains are usually larger.) The inside track is connected with one side of the motor and with one side of the battery. The opposite side of battery connects with push button 4 and switches 5 and 6. Button 4 connects with an insulated section 7, 3 feet long, set into the outside track. Switch 5 connects with the main outside track, and switch 6 with the remaining side of motor. The train always stands at station 8 until button 4 is pressed, when it makes a circuit of the garden, and stops at station 8 until the button is again pressed. This feature is not only interesting, but saves the battery. The switch 5 controls the railroad system, and switch 6 the water system and windmills. A small motor costing $1.50 is arranged as shown in Figs. 1 and 7. The shaft 9, carrying wheel 10, is ⅛ inch diameter and 4 feet long. It is designed to operate the windmills in the manner shown in Fig. 1. Waxed thread is used for belts. The lift is made of an endless brass-wire sprocket chain passing over 1-inch wheels at top and bottom. Small buckets of painted tin are soldered to each sixth link. The wheel centers are 10 inches apart.

Fig. 6 illustrates clearly how the water is fed underground from the mountain lake to the falls 1 and 2. A 30-inch length of ¾-inch copper tube is used here. Figs. 3 and 4 illustrate the manner of mounting the mill wheel.

Old cigar boxes and similar light material are employed to form the frame of the waterways, hills, etc. For the streams, these are cut as in Fig. 5; for other parts, they are cut and arranged as required. Short lengths of copper wire are bent to necessary shapes, and fastened in place with small staples. For large areas rust-proof wire netting is bent and tacked to the frame. Irregular pieces of tough paper, dipped into oil paint, are laid on the network of wires to a thickness of several layers. The beds of the streams and lakes are covered with five layers. When the paint is thoroughly dry, the waterways are spread with several coats of good shellac.

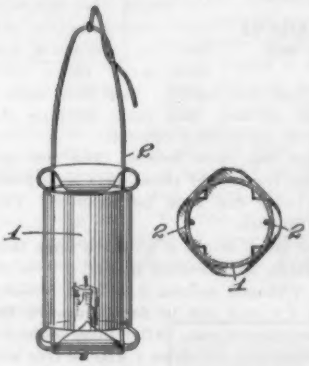
For a summer garden, paint the "ground" a flat grass green, and cover judiciously with artificial moss and trees. For a "winter" scene paint the ground a flat white, and cover with raw cotton and snow-laden trees. Sprinkle with artificial snow. A quantity of gravel in the streams, a sailboat or two on the lake, ducks, horses, etc., and even people placed around the garden, give life to the scene.

A REAL LIVE WINTER SCENE UNDER THE TREE.

PROTECTION FOR CHRISTMAS TREE CANDLES.

BY C. H. RUTHERFORD.

It is a foolishly dangerous practice to risk the consequences of fire from the unprotected lights commonly seen on Christmas trees. In the accompanying illustrations I have shown how a very simple and ornamental protector may be made at home. The cylinder 1 is preferably of glass, but a wire netting may be used with entire satisfaction. The top and base are each made from a piece of tin cut 1⅞ inch square. They are identical, and are punched with two holes to receive the wire 2. The corners are bent inward just far enough to enter the ends of the tube. To light, slide the tube along the wire until the wick can be reached. The tube should be 3 inches long by 1½ in diameter.



PROTECTION FOR CHRISTMAS TREE CANDLES.

Some Home-made Christmas Presents.

FLEXIBLE MIRRORS.

BY LEONARD P. GREENE.

Mirrors which can be bent into any desirable shape, or can be cut to conform to any pattern, can be made by the following process: Coat stout paper or tissue with three or four coats of white of egg, allowing each coat to dry before applying the next, and then apply several layers of transparent varnish to the thickness of mirror glass. Smooth a sheet of tinfoil, and apply to it several coats of waterproof varnish. When dry, glue the varnished side of the foil to paper, tissue, or whatever substance is to form the permanent support of the mirror. Spread mercury on the other side of the tinfoil, forming an amalgam. On this lay the varnished surface of the first paper, applying first a transparent glue, very thin.

Subject the whole to a strong pressure, as in a letter press, letting it stand for at least twelve hours. The upper paper is now removed by moistening with water until the white of egg is dissolved. The result of the operation will be an actual mirror, the beauty of which will of course largely depend upon the clearness and transparency of the varnish used. The mirror may be made in such a form as to fit the place it is to occupy. But this is not absolutely necessary, since the finished mirrors can be bent into any desired shape.

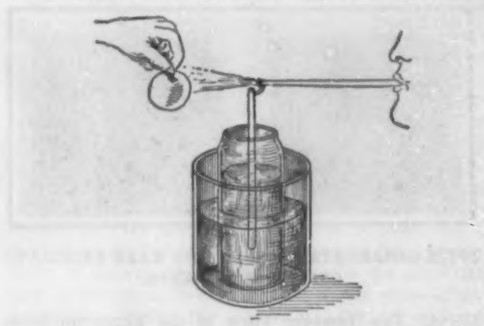
Beautiful effects can be produced by using colored mirrors, which are obtained in the same manner by substituting a varnish of the desired color over the white of egg.

COPPER-PLATING FLOWERS AND OTHER PERISHABLE ARTICLES.

BY W. J. J.

The following process of preserving objects as souvenirs in a state where they will not only retain their original shape, but have their appearance greatly added to, while comparatively simple, depends for its success on the thoroughness with which the different operations are performed.

The requirements consist of any common form of

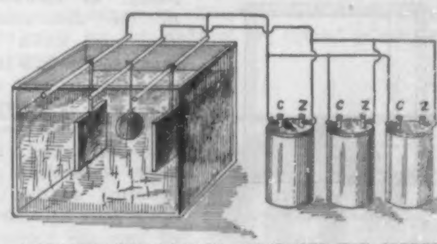


COATING THE OBJECT WITH WAX.

battery—three Daniell or two Bunsen cells connected for intensity, will be found sufficient—a large stoneware or glass pot large enough to hold the object, and two rods to fit across the top. The stoneware pot is now filled with the usual copper sulphate solution used in plating, namely, 4 pounds sulphate of copper, 1 pound sulphuric acid, 18 to 20 pounds water. The solution should be filtered. The object to be preserved is suspended in the solution, and attached to the zinc wire of the battery. To the other wire a piece of copper is hung. So far the process is that of copper plating. In order to obtain an even deposit of copper, however, on the objects, they must be prepared beforehand, and this is where the skill is required. The list of objects that can be thus coppered is large, and each will in a measure require different treatment.

If, however, I describe the handling of two or three different kinds, the necessary requirements will be made plain to anyone accustomed to copper plating.

One popular souvenir is "baby's first shoe" when it has arrived at the cast-off state. The shoe is taken and washed thoroughly to remove all grease, such as polish. It is then coated evenly with graphite, which is well rubbed into the leather inside (as far as pos-



HOW THE BATTERY IS CONNECTED FOR COPPER PLATING.

sible) and out. The laces tied in a bow left half way up the shoe add to the appearance when finished. When this is covered with copper it presents a very solid appearance, and can be left dull or polished in places. The exact appearance of the shoe is retained.

A piece of lace makes a very pretty object when covered with copper, as it has the appearance of being woven in copper thread. The lace must be well covered in graphite, the best method being to pin the lace on a board and rub the graphite well into the fabric with soft linen. In suspending it in the copper solution, it must be spread out and held in position by means of small shot tied to it by means of thread, to keep it vertical. If a very delicate piece of copper lace is silvered afterward, the effect is very fine.

The most beautiful object is perhaps a flower covered with copper, and this requires special treatment.

Let us take a simple flower as a sample. A daisy is covered by means of an atomizer with a thin coating of paraffine wax, care being taken that all parts are covered. On cooling, the wax-coated flower is dusted over with graphite, and when thoroughly covered is treated as other objects described above. A half-

opened rose is more difficult to spray with wax, but when cool the petals can be moved to any desired position. A rosebud is comparatively simple, requiring only to be dipped. Leaves and other objects of a similar shape need not be waxed if the graphite will adhere without. Copper-coated flowers are now being used as hat pins, and make very artistic Christmas presents.

The best form of atomizer to use is one composed of two tubes at right angles to each other, the vertical one being inserted in the hot wax, which can be kept in a water bath. By blowing in the horizontal tube, a fine spray of wax will cover the flower.

In order to obtain an even coating on the object, a good method is to have two copper wires from the carbon, and hang a piece of copper on each side. If this is not done, the object must be turned at intervals.

ORNAMENTAL CONCRETE FLOWER POTS AND HOW TO MAKE THEM.

BY RALPH C. DAVISON.

The majority of people know something of concrete and of its advantages for a building material, especially where strength and fire-resisting qualities are a

THESE ORNAMENTAL FLOWER POTS MAKE EXCELLENT CHRISTMAS PRESENTS.

factor. Few however know of the wonderful ornamental possibilities which can be obtained with it by a little ingenuity in the selection of the proper aggregates and the imbedding of tile arranged in varying designs.

A most interesting example of this work, the conception of Mr. Albert Moyer, is displayed in the permanent exhibition hall of the Concrete Association of America, New York. Here are to be seen a number of highly decorative flower pots. These look as though they were difficult to produce, but they are simple to make when one knows how.

Concrete is a mixture of cement, sand, and stone; to this is added the proper amount of water and the whole is then worked into a pasty mass. Thus the concrete mixture being of a plastic nature, can be molded or cast into any desired form.

Therefore the first thing to do is to prepare a mold in which the pots are to be cast. A detailed drawing for a pot 9 inches square by 10 inches high is shown in the accompanying illustrations. Use wood not less than ½ inch thick, ¾ inch or 1 inch would be better. The outside form, Fig. 1, should be made first. This is nothing but a wooden box with the top left off and the bottom nailed on from below. Use as few and as small nails as possible. Three on each side will be plenty, as indicated in the illustration. The core, which is shown in Fig. 2, is the most difficult part to make. It is in the form of a tapered box, and must be made of sections as indicated, so that it can readily be removed after the concrete has set or hardened. After completing the mold, the concrete mixture should be made up. This should consist of 1 part Portland cement, 1 part good clean sand, and 4 parts of an equal mixture of marble chips and trap rock varying in size from ½ inch to ¾ inch. If marble is not available, very effective results can be obtained by using broken brick with the trap rock. Mix the sand and cement together thoroughly while dry, wet down the marble and trap rock by dipping it in a pail or sprinkling with water, and then add it gradually to the sand and cement, thoroughly mixing the whole, and at the same time adding enough water to make it the consistency of a good heavy cream.

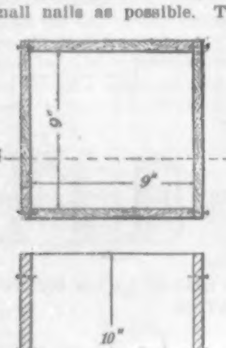
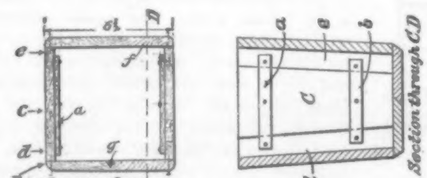


Fig. 1.—THE OUTSIDE FORM OF THE FLOWER POT MOLD.

The next operation after mixing is the pouring or placing of the plastic concrete into the mold. This is done as follows: First fill the mold solid up to a level with the bottom of the core, pack the cement down well, and then place the core box in position, as indicated in Fig. 3. Be sure that it rests solid on the concrete which is already placed, and that it is centered in the box. This is important, for if the core is not exactly in the center, the sides of the pot will not be of equal thickness. A good way to center and secure the core in position is to nail a strip of wood to it, and in turn nail the ends of this strip to the top of the outside form, as shown in Fig. 3. This will also keep the core down in place. After the core has been placed, and secured as above, fill the rest of the mold with the plastic concrete, packing it or ramming it down well with the blunt end of a stick. When the concrete mixture reaches the top of the mold, smooth it off nicely, and set the mold and its contents on a level place to let the concrete set or harden. In twenty-four hours from the time of pouring (do not let it be longer than this, for if so the concrete will be too hard for treatment) the concrete will be sufficiently hard to remove the molds. This should be done carefully, in order not to break the corners, as the concrete is yet more or less soft. First remove the bottom and then the sides of the outer mold. These should come off easily, unless there have been too many or too long nails used. As yet do not attempt to take out the core, as the concrete is not hardened, and the core will help to hold it up. After removing the outer forms, the surface of the concrete will appear comparatively smooth and uninteresting. The next operation is to wet the concrete surface down lightly by dashing water on it, and then to gently scrub it with a stiff brush, such as an ordinary house scrubbing brush. This operation will remove all of the surface cement and will expose the aggregates, that is the pieces of trap rock and marble which were used in the mixture, thus producing a surface similar in some respects to a black and white mosaic. If it is found that in some places the surface cement will not



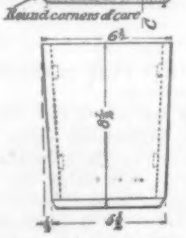


Fig. 2.—DETAILS OF THE CORE BOX.

come off by rubbing with plain water and a brush, a solution of 4 parts of water to 1 part of commercial muriatic acid may be used. Apply this with a brush, and be careful not to get it on the hands. Let this solution remain on the surface for 15 minutes, and then scrub again with clean water and rinse thoroughly. This will leave a good, bright, clean surface, each stone sticking out boldly and free from all surface cement.

After the surface has been treated thus, the pot should be put away for two or three days to dry out and harden. The core can then be removed. This should be done as follows:

First remove the small strips *a b*, which have been nailed from the inside, as indicated in Fig. 2. On removing these the V-shaped section *c* will be released from the sections *d e* and can be forced toward the center of the pot and drawn out. After these V-shaped pieces have been removed, the sides *f* will be free and can be collapsed toward the center, and in turn can be removed. The bottom, which is made in two pieces, as shown, will then release itself freely. Before pouring the concrete mixture it is well to grease all parts of the mold, which come in contact with the plastic concrete, with a heavy oil or vaseline. This will prevent sticking, and will allow the mold to be released readily from the concrete after it has set up or hardened.

Many will probably ask why it is necessary to have a collapsible core. Why will not a plain, solid box do? The reason for this is that in pouring your wet concrete mixture, more or less moisture is absorbed by the wood mold, thus causing it to swell. If the core were made solid, it would be next to impossible to remove it without cutting it to pieces.

Therefore, in order to prevent any undue strain on the fresh concrete by hammering or cutting on a solid core in order to remove it, and also in order to be able to save the core, so that it can be used over and over again for other casts, it is always better to make a collapsible core, as shown in Fig. 2.

So far the method of procuring a mosaic effect has only been explained. But by exerting a little artistic taste, by the incorporation of colored tiles in pleasing designs, one can produce some very interesting and really striking results.

There are various means which can be employed for inserting the tiles in the outer surface of the pots. One is to place in the outer mold a negative mold. This is done by cutting out a piece of wood the exact shape but a trifle larger than the tile which is to be inserted, and nailing it in the desired position to the inside of the outer mold. On drawing the outer mold this will leave a cavity in the outer surface of the pot, into which the tile can be cemented. In cementing the tile in place, the surface of the pot as well as the tile itself should be well soaked with water. Use a mortar composed of 1 part cement to 1 part fine sand. Another method for placing the tiles is to bore small holes through the outer forms, and secure the tiles to the inside of the outer forms by tying with string, as indicated in the illustration; care being taken to see that the ornate side of the tile is placed next to the wood. Then pour in the plastic concrete as you would proceed to do in an unornamented pot. Before removing the outer forms in this case, however, the strings which hold the tile in place should be cut. This is

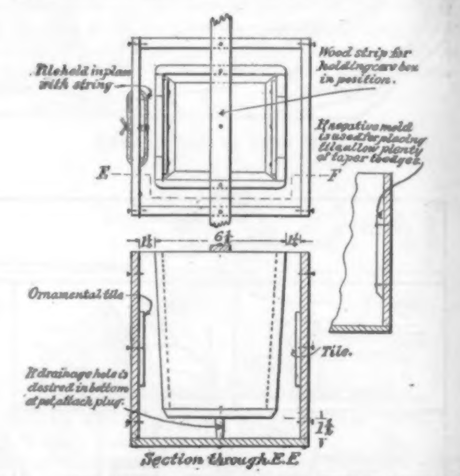


Fig. 3.—THE MOLD ASSEMBLED FOR THE PLACING OF THE CONCRETE.

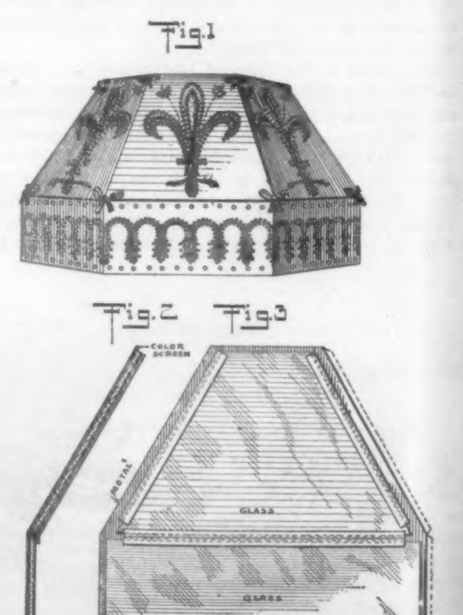
perhaps an easier method of placing the tile than that of making a negative mold. But in some cases it is hard to get the plastic concrete to flow completely around the tile. If in removing the forms, however, it is found that there are some places where the concrete has not run up to the tile, these holes or "voids," as they are called, can be filled in or pointed up by cementing small pieces of stone in them. Anyone making a vase or pot after the above directions will be amply repaid for his trouble; for the work is interesting, and is suggestive of an unlimited number of designs and combinations, each of which will contain more or less individuality.

HOME-MADE METAL LAMP SHADE.

BY B. A. JOHNS.

The accompanying sketches show a simple and yet effective way to make a metal lamp shade. When the desired size, shape, and general style of the shade is selected, a diagram is made, from which the blanks or sections are made. The blanks are cut out from some thin metal, such as copper, brass, or black iron, with a small strip on one side, as indicated in dotted lines in Fig. 3. This flap is to be turned in and soldered to the adjoining blank.

Now trace the desired design on the blank, which may be a conventional flower or anything that ap-



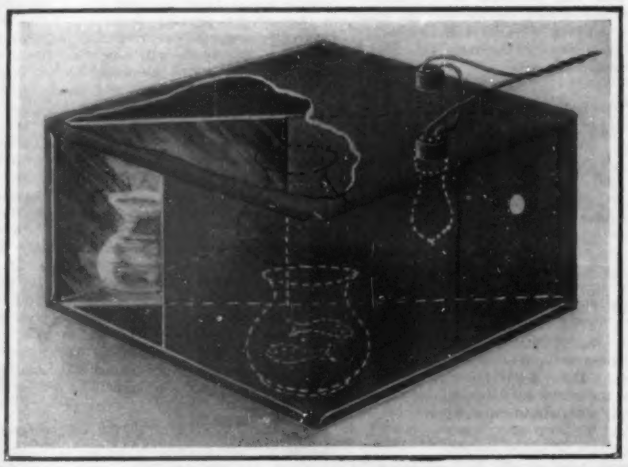
HOME-MADE METAL LAMP SHADE.

peals to the fancy of the maker. **Put a blank on the** end of a hardwood block, such as maple, and with a small punch, any shape, punch out the outlines of the design as closely as possible. After this the blank is turned over and laid on a piece of soft iron, and with a small prick punch a number of indentations are made in it between the outlines of the design.

After the blanks have thus been prepared, solder strips of metal on the inside, for the purpose of holding the glass, also to make the blanks stiff (Fig. 3). Now solder the blanks together. Small bows of lead ribbon may be made and fastened at the corners, giving the impression that the several blanks are tied together. The shade is now ready to be painted. Use any kind of paint that will dry flat, such as ivory black. When dry, place between the glass and the frame a color screen of colored gelatin or celluloid. Different colors may be pasted on the glass, side by side, so as to bring out the different colors the design is supposed to represent. For instance, if the design should be a bunch of cherries on a twig, red may be used for the cherries, brown for the stem, and green for the leaves.

When the glass is finally put in place, the pieces of metal soldered on the inside of the shade are now turned over, so as to hold the glass in place. Care should be taken that the glass does not fit too tightly. Always give it more or less room to allow for thermal expansion. A string of beads may be fastened to the bottom or lower edge of the shade.

The shade may be made of paper, in which case two blanks are used. These are fastened and perforated at the same time with a large needle over a small cushion of sand or emery. The color screen is then inserted between the blanks, and the latter are bound together with ribbons. Another pretty effect may be obtained by using two blanks of white Bristol board, without any perforation, and instead of the color screen, place between the sheets some pressed flowers, leaves, grasses, or the like.



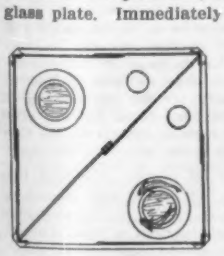
THE GOLD FISH APPEAR AND DISAPPEAR AT THE TOUCH OF A SWITCH.

The Christmas Entertainment.

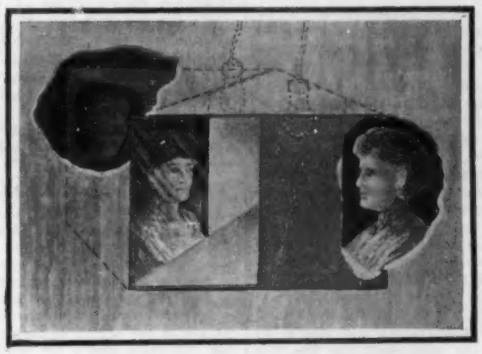
A PUZZLING DISPLAY BOX.

BY FRANK C. PERKINS.

An interesting electrical illusion box has recently been devised, which is well within the ability of a handy man to construct. It consists of a perfectly square box of any material, such as wood or tinplate soldered together. The box is divided into two compartments by a diagonal partition consisting of two sections of equal size, one of the sections being a glass plate. Immediately in front of the glass section there is an opening in the box, through which observers can view the illusions. The whole interior of the box except the glass plate is painted a dead black. The illusion is produced by placing two objects in the two compartments. One of these objects may be a globe containing gold fishes, and the other a globe of identically the same shape, but empty. The compartments are lighted by two electric lamps symmetrically placed, one in each compartment, but out of range of the opening in the front of the box. When the lamp in the forward compartment is lighted, the object therein will be seen by reflection in the glass. When the switch is thrown to put out the light in the forward compartment, and to light the lamp in the rear compartment, the other object only is seen through the glass partition. In this way the fishes in the globe may be made to appear or disappear as the operator desires, by the manipulation of the switch. An interesting adaptation of this box is to provide an opening in the side of the box, as well as one in the rear opposite the front opening, so as to permit two persons to place their heads in the compartments. These persons will be hidden behind a curtain, as indicated in one of the illustrations. Now, on operating the switch, first one face and then the other may be made instantly to appear in the box. If a dimmer is used, which will gradually shut off the light of one lamp while turning on the light in the other, one face may be made to fade and merge into the other. This illusion box should make an interesting feature of the Christmas entertainment.



SECTIONAL PLAN VIEW OF THE ILLUSION BOX.



ON TOUCHING THE BUTTON ONE FACE MERGES INTO THE OTHER.

A TRICK WITH TOURMALINE.

BY PROF. GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

The little apparatus here described allows one to see easily any object in spite of an obstacle which will prove insuperable to all eyes but yours. The principle which underlies the experiment is not widely known among persons who have not made a study of optics, and the performance always causes considerable curiosity, even after the mystery has been duly explained.

You hold a plate of transparent, colorless glass in your hand, and ask the company whether anyone feels sure he can always read plain writing or print directly under the glass, within a reasonable distance from the eye and with plenty of light falling upon it. Upon receiving an affirmative answer, you bring a table near the window. The plate of glass, with some printed matter under it, is laid flat on the table, close to the window. A few books are piled on the other end of the table. You rest your chin upon them, and then move the plate of glass until you can see the luminous sky reflected on the glass under an angle somewhat smaller than 45 deg. (34 deg. will give the best results, but there is no need of accuracy). In such circumstances you will find yourself unable to see anything under the glass. The assistants may try, one after the other, to take your place and read the script; their attempts are vain. On the plate they see the bright sky. Under it they see nothing, not even the shape or color of the sheet of paper. The intense light reflected on the surface of the glass decreases the sensibility of the retina, closes partially the pupil, and prevents the seeing of anything which is much less luminous than the sky.

You draw from your pocket what seems to be a small disk of common green glass framed in a piece of cardboard. You pass it along. It is neither a prism nor a lens, and changes nothing in the position or shape of objects, yet through it you read aloud at once the invisible script under the glass. Your neighbor confidently takes your place with the green glass in his hand. He occupies exactly the position you occupied; he holds the glass exactly as you did, only to find matters a little worse than before. The bright sky on the glass has become greenish, but there is not the slightest indication of anything lying under the glass. The game may last as long as you wish. Anybody in the company may change the script for another. You can always read it, nobody else can. Finally, you kindly allow everyone to be as clever as you are, and from that very moment, although no perceptible change has occurred anywhere, everbody can read through the green glass, but only through it. The bright sky has apparently vanished; the script is distinctly seen and easily read.

The key to the mystery is the peculiar nature of the intense light sent by the surface of the glass. What seems to be a single plate of glass is a bundle of three plates, which have been framed together with some *passe-partout* binding, care being taken to keep them apart with strips of the same binding stuck on the margins of the plates. Light reflected upon such a bundle of plates is nearly entirely polarized, whenever the rays make with the plates an angle which is not very far from 34 deg. Our eye makes no difference between polarized and ordinary light, but a slice of tourmaline, which is transparent for ordinary light, is opaque for polarized light if the principal axis of the tourmaline be parallel to the plane of polarization. During the experiment, the eye receives both the dazzling light reflected on the plates and the comparatively faint light sent by the script. The tourmaline is opaque for the first-named source of light, and transparent for the second. It acts as a filter, which allows only the passing of such light as is helpful in reading the script.

But to deprive the tourmaline of its opacity for polarized light, it suffices to place its principal axis perpendicular to the plane of polarization, that is, at right angles with its previous position. This is easily done, and without running the risk of being detected, by a twist of the fingers laid on the cork mounting of the tourmaline. Another quarter of a revolution will restore to the tourmaline its filtering properties. The line cut illustrates the mounting of the tourmaline. *P* is a holder of black pasteboard, *C* a cork disk cut out of a common stopper, *T* a slice of tourmaline, and *B* black paper which gives the tourmaline the appearance of a disk.

During the experiment, the main light should not come from more than one window. If this precaution be neglected, the relative amount of diffused light sent by the script is increased, and some black and white may be perceived under the glass. Slices of tourmaline, cut parallel to the principal axis of the crystal, are sold at a moderate price by dealers in laboratory apparatus. They are used mostly by mineralogists for the study of the optical properties of crystals.

The invisible printing is read easily through what appears to be common green glass.

A TRICK WITH TOURMALINE.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

TROUSERS-STRETCHER.—R. C. Mitchell, Fayetteville, Ark. This invention has for its object the provision of features of construction for a trousers stretcher which afford a light, strong, shapely and very convenient device of the character indicated, that is adapted for manufacture from metal rapidly and perfectly by machinery, at a moderate cost.

NECKTIE.—M. Prager, New York, N. Y. More particularly this invention relates to neckties which are tied or knotted by the wearer. An object of the invention is to provide a tie, cravat, scarf or similar article of apparel which can be tied or knotted by the wearer, which tends to retain its normal shape for an extended time and which does not show creases or fold marks.

GARMENT-HANGER. — A. K. Bowman, Greensburg, Pa. The invention is designed particularly to improve that form of hanger that consists of a hanger bar adapted to support a coat, skirt, or other garment, and a suspension hook in the hangers as generally made, being fixidly secured in place, which makes the hangers bulky, and hence inconvenient for packing, etc. The object is to provide a hanger having a detachable hook, thus materially economizing space in the packing, shipping, and storing of the hangers.

Of Interest to Farmers.

CULTIVATING-SCRAPE. — A. F. Davis, Marion, Ala. The scrape is adjustably connected with a plow stock in such manner that the former can be run shallow or deep as required, and further, so that the scrape under all adjustments can be run flat, presenting its entire cutting edge to the earth, weeds, bushes, etc., in the most effective manner with the least possible draft resistance and without a tendency to turn in either direction, or to tilt forward or backward while being run or used, thus providing a balanced and adjustable scrape.

HOG-TRAP.—W. S. Phillips, Wolfrun, W. Va. This structure provides a means for properly securing a hog for ringing it or performing other operations on animals. The hog is driven into the structure through a rear door so that the door may be moved forward by ropes and a winding shaft to force the animal to point his head through the slatted front door, where it can be secured. It is adapted to be thrown so as to have the animal on its side when the operation to be performed requires it.

Of General Interest.

DIGGING IMPLEMENT.—J. P. Manahan, Red Bank, N. J. The implement or spade has a blade provided with laterally disposed sides, and at the side edges and at the lower edge cutting teeth or serrations, the blade having secured thereto a handle provided with transverse rings and itself having an opening which serves, like the rings, to receive the foot of the operator, who can thus apply his weight at successive supports in forcing the implement gradually into the ground.

PLANE.—A. Link, St. Paul, Minn. An object of this inventor is to provide a plane for cutting grooves or rectangular cavities and having means for easily and rapidly adjusting the cutter. The device has handles, by means of which it can be manually operated, and has a cutter adapted to be projected from the plane stock, one of said handles controlling the cutter and serving both to operate the plane and to adjust the cutter.

SHAVING-CUP.—J. Holzsager, New York, N. Y. This sanitary cup is adapted to retain a cake of soap in the center of its bottom and provides a rubbing surface about the soap. The bottom is constructed with a central depression and the adjoining portion of the bottom is made at a higher level to provide an annular rubbing surface, whereby the brush may have a complete sweep on this surface around the soap in the production of the lather. A handle and dischage spout are provided, the latter permitting tilting for pouring off an excess of water or draining the cup.

MEASURING-HOPPER.—C. Suiter, Billings, Mont. This invention refers to a measuring or portioning hopper capable of use in many ways, but especially adapted for mixing materials for compositions, the principal object being to provide means whereby predetermined quantities of the materials for a composition can be fed simultaneously from the hopper.

WINDOW.—A. C. Goddard, New York, N. Y. The object in this case is to provide certain new and useful improvements in metallic windows, whereby the window is rendered dust-proof and the sashes are efficiently held against rattling. By the arrangement an exceedingly strong and durable sash is provided, securely holding the panes in place.

CIGARETTE-CASE.—B. Epstein, New York, N. Y. This invention pertains to pocket cigarette cases such as carried by cigarette smokers. The inventor's purpose is to produce a case which can be very economically formed, and which will present pockets from which the cigarettes may be readily removed.

COMB-CLEANER.—F. Fevola, New York, N. Y. Means provide for engaging the opposite ends of the comb and a member supported adjacent to said means and having teeth adapted to intermesh with the comb teeth where one or the other is revolved, the member being interchangeable with other like members and laterally adjustable with respect to the comb in order that the device may be used in cleaning combs having the teeth of varying depths and spaced different distances apart.

SUPPORTING DEVICE FOR UMBRELLAS. —F. B. Cumpston, Blooming Grove, Tex. In the present patent the invention has for its purpose the provision of simple means for adjustably supporting an umbrella or the like, from the person of the user of the device, and thus permit the free use of both hands and arms as occasion may require.

FORM FOR ANIMAL-HEADS.—B. Cohen, New York, N. Y. The invention provides a form for heads, made of soft rubber, having a skull portion, an under jaw and snout portion, and a lower jaw or tongue, all rendered practically indestructible and sufficiently flexible, at the same time properly displaying the head of a fur skin fashioned over the form and without danger of losing its shape. It relates to heads such as shown and described in Letters Patent of the U. S., formerly granted to Mr. Cohen.

FOUNTAIN-PEN.—J. Board, Chester, N. Y. When the pen is used, the ink will feed to its point, and when not being used, the flow will be shut off. In other words, the flexing movement of the point is utilized to stimulate the feeding action; but the construction is such as to enable the pen to be carried in the pocket even in an inverted position without leakage from the reservoir.

AIR-PRESSURE SYSTEM FOR TURRETS AND THE LIKE.—H. Bensch, New York, N. Y. The improvement pertains to high power ordnance, and more particularly to means whereby after the gun is fired and the breech block opened for reloading, the gases of combustion are completely scavenged from the bore of the gun and "flarebacks" positively prevented.

ATTACHMENT FOR DRIVING-REINS OF DOUBLE HARNESS.—J. Sutherland, Springer, New Mex. The object here is to provide an attachment for double harness which will prevent an accident occurring, by rendering it impossible for the connecting buckles between the long and short members of each pair of reins from passing through a complementary terret ring, or from becoming so engaged therewith as to prevent full control of the reins and the horses connected thereto.

SAW-FILING DEVICE.—H. F. Hill, Scotia, Cal. This device can be easily set up in position on an ordinary work bench, and which will operate to guide the saw in the filing operation, the arrangement being such that the file may be advanced by a simple movement from one end of the saw to the other as the operation progresses, and the file is constantly maintained in a fixed relation of inclination with respect to the blade, so that the edge given to the teeth will be uniform.

POCKET-KNIFE.—R. L. Guthrie, Skagway, Alaska. The object of this invention is to provide an improved handle for use in interchangeably holding all sorts of knife blades, screw drivers, manicure implements, etc., and arranged to permit convenient and quick removal of a tool and the insertion of another.

MACHINE FOR MAKING RIMS FOR SOFT PIES.—J. F. Kohler, New York, N. Y. One purpose of the invention is to provide a special type of head for automatically pressing dough fed to the machine in rims in pie plates, and constructed in annular sections, which sections act upon the dough consecutively from the inner outwardly, as the head is brought into shaping position, automatically releasing the pressed dough in reverse order as the head rises, thus insuring the pie plate remaining in position during both of the operations, and the dough remaining upon the plate.

Machines and Mechanical Devices.

OPERATING MECHANISM FOR REED-ORGANS.—H. E. Chute, Peru, Ind. This improvement is in mechanism particularly adapted for use in reed organs for controlling the notes of the organ, the active coupler, and the like, and resides in the arrangement of this mechanism, whereby the desired movement of the parts may be obtained and controlled by the treadle of the organ.

TRAVELING CRANE.—L. H. Miller and G. A. Newcomb, Tacoma, Wash. In the present patent the invention has reference to traveling cranes, the more particular purpose of the inventors being the provision of a crane having quite a variety of independent movements all reversible and readily controlled at the will of the operator.

GEARING.—W. Lesemann, Egg Harbor City, N. J. This invention refers to a reversible gearing in which the drive shaft may be given a forward or a backward rotation by simply moving the lever to the right or to the left. Moreover, by moving the lever to a central point the gearing can be released and the loose pulley on the shaft will then revolve idly.

APPARATUS FOR DEMONSTRATING AND ILLUSTRATING WAVE MOTIONS. — C. Forbes, New York, N. Y. In this case the invention is an apparatus for use in the demonstration of the formation and propagation of water or surface waves, waves of condensation and rarefaction, as sound waves, and transverse waves, as the ether waves of light, heat, and electricity.

SPRING.—L. Y. Leon, San Juan, Porto Rico. The more particular object here is to produce a kind of spring consisting of two members each having substantially the form of a ribbon, these two members being disposed symmetrically in relation to each other for the purpose of increasing the durability and the elasticity of the metallic members of the spring.

CENTRIFUGAL PUMP.—L. Bellot, 3 Boulevard Richard Lenoir, Paris, France. The invention comprises in a pump, the combination of a fixed central distributer and a hollow annular impeller, provided with a series of guides arranged in a general radial direction and having a special double curvature, the concave portions of the guides being arranged contiguous to the distributer, so as to utilize the first impact of the liquid while the outer convex part of the guides serves as a piston.

Prime Movers and Their Accessories.

EXPLOSION-TURBINE.—C. Beckman, New York, N. Y. The object of this invention is to produce a prime mover simple in construction and efficient in operation. Further objects are to provide an arrangement which will enable the motor of the machine to act as a carbureter, to provide improved means for feeding the charges to the explosion chambers, and to provide important means for igniting the same.

Railways and Their Accessories.

AUTOMATIC SAFETY-SWITCH.—J. Thornton and I. Wertheimer, New York, N. Y. The inventor relates to railway switches, and the object is to produce a switch which if left open in such a way that a train running at high speed on the main track could run upon the siding, the switch would be closed automatically. In this way accidents will be avoided.

CAR-STAKE.—J. Bagley, Tacoma, Wash. This invention is an improvement in car stakes such as are used on flat or like cars, and has for its purpose the provision of a comparatively light and strong device of this character, which may be released instantaneously, with other like stakes at the same side of the car and be easily erected.

Pertaining to Vehicles.

BUGGY-SHAFT SUPPORT.—B. M. Perdue, Franklin, Ky. When the animal is unhitched, the shafts are lifted out of contact with the ground, so that there is no liability of breakage. When it is desired to hitch to the buggy, the animal may be led under the shafts. In this position, the spring is under tension, since the arms are more nearly in alinement with each other. After the animal is hitched, the tension of the spring keeps the weight of the shafts off the horse's back, and immediately returns them to their elevated position when the animal is unhitched.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Full hints to correspondents were printed at the head of this column in the issue of November 14 or will be sent by mail on request.

(10999) A. M. St. C. says: I see in the papers that Halley's comet is expected soon. Can you tell me about when it will be visible and about when it will pass perihelion? A. The search for Halley's comet has already begun at the large observatories by means of photography, and will be kept up till the comet is discovered. It will doubtless be found on photographic plates before it can be seen by the eye. It is due to pass perihelion in May, 1910. We cannot say when it will become visible to the eye.

(11000) F. S. asks: Will you kindly inform me as to whether or not there is any reason for the common opinion of boatmen that waves become heavier in the fall as the water gets colder? Here on Leach Lake every boatman will tell you that this is the case. I can see no reason for believing that there is anything back of this idea. A. We never heard the opinion you give as common among boatmen that waves are heavier in fall than in spring, and cannot give any reason for such an opinion.

(11001) J. L. H. says: Will you be kind enough to advise me what is meant by the use of the term "boring the tubes" in connection with the tunnels under the river; whether the tube was actually driven by hydraulic pressure under the river or dug by the same process as the subway was built, pick and shovel? A. We cannot settle your bet, but we can give you enough information to enable you to judge which of the parties was correct. We cannot give a full explanation of the process of shield tunneling, for which we must refer you to our Supplement Nos. 1027, 1028, 1042, and 1122, which give most interesting details of the methods employed in London tunnels and copied almost exactly here, or No. 1474, which gives fairly late particulars of the Hudson tunnel. These are excellent descriptions for the non-technical man, of a most interesting subject, and will be sent you for 10 cents each, postage paid. The shield is essentially and was originally intended to be a portable false work for taking the place of timbering and retaining the roof and sides of a tunnel in soft ground during the process of excavation and until the masonry or permanent ironwork could be placed. The ground in front of the shield is blasted, if rock, and removed by pick and shovel, if soft enough, and when sufficient has been excavated for one "ring" of iron or masonry to be erected behind it, the shield is pushed forward by hydraulic power. In so far the hydraulic pressure has no connection with the actual excavation, but in a considerable part of the tunnels under the Hudson the ground excavated was in so nearly a fluid state that it was only necessary to apply hydraulic pressure to the shield to force it through the silt, which squirted through apertures in the shield like paint out of a compressible tube, directly into cars, by which it was conveyed out of the tunnel. The direction of the shield was controlled by the admission of a greater or less, or a higher or lower portion of the silt. In this use of the shield the hydraulic pressure may certainly be said to have performed the actual excavation. There were also considerable sections of the tunnel in which the shield, with its apertures closed, was simply pushed through fluid silt, which was forced to one side, no part of the ground being "excavated" in the usual sense of the term, but in this use also the tunnel may be said to have been "dug" by the hydraulic pressure, since the latter forced the opening filled by the completed tunnel.

(11002) W. B. H. says: 1. Will you please explain in your notes and queries the wiring and working of an induction coil with only three wire terminals? A. We know no way in which an induction coil can be made with three terminals. A wire is sometimes bridged across from one end of the secondary to one of the primary terminals. This will apparently suppress one terminal, but only apparently. The spark will now jump from the single terminal of the secondary to one of the terminals of the primary. 2. The connections at the dynamo of a three-wire lighting system where either 110 or 220 volts can be obtained? A. There are several modes of making connections for a three-wire system, giving either the whole or half the voltage, 220 or 110 volts. We would refer you for diagrams and explanations to our Sloane's Handy Book of Electricity, pages 497 to 502, which we send for $3.50 postpaid. 3. Have you any Supplements which explain the working of an alternating-current brush motor with slip rings instead of a commutator? A. Alternating-current motors have slip rings and do not have commutators. You will find this subject also fully treated in Sloane's book, pages 348 to 438. This book may be said to be indispensible to one wishing a knowledge of modern electrical machinery.

(11003) For W. G. F.: The article relating to the Fermat formulas, published in our issue of February 1 last, has called forth much correspondence. Yet so far as we can judge none of the letters are from persons versed in pure mathematics. One would think that a proposition which, as the article states, the great mathematicians of the world have not been able to solve, would hardly be solved by those unfamiliar with the subject involved. The theorem is, the sum of the cubes or any higher power of two numbers cannot be equal to the cube or the same higher power of any other number. That is, $X^n + Y^n = Z^n$, is not true if n is greater than 2. This is the proposition which has never been proved in general terms. Most of our correspondents attempt the proof by citing numbers, and applying the formula to successive numbers. This is not the proof required. One could not to all eternity complete the proof of a negative in this way. There is an infinite series of numbers, which must be tested two by two, and eternity is too short for the task. What is required is a demonstration in general terms that there is no possibility of finding any such numbers. Such a demonstration must be in letters, and not in figures. We do not expect any one to secure the prize offered for the proof of the theorem, and would request that no more letters be sent us on the subject. Any one desiring to submit anything in competition for this prize should send their articles directly to the German address given in the article in our paper.

(11004) J. T. M. says: I would like to know the best oil or the best method of oiling ball bearings, or if it is absolutely necessary to oil ball bearings or not. This information will be greatly appreciated, and I feel that coming from you it will be correct. A. Theoretically it is not only unnecessary to oil ball bearings, but better not to: anything which assists the ball to slip on either surface reduces the static friction between ball and cone, which causes it to roll and makes the bearings nearly frictionless, and if the ball begins to slide it soon wears a small flat patch on it, which prevents its properly performing its function. The better a ball bearing is made the less the necessity of oiling it, but at the same time the almost universal practice of oiling ball bearings (or filling them with solid lubricant) goes to show that it is found to have practical advantages. The excuse for oiling ball bearings is that if not perfectly fitted the balls may touch each other,

and if the front side of one ball comes in contact with the hind side of another, both rolling in the same direction, the kinetic friction between them is double that between either ball sliding without rotating and the cone on which it slides. With which explanation of the reasons pro and con we must leave you to judge whether or not it is better in your case to oil or not.

(11005) T. L. G. says: You will do me a favor to decide in your Notes and Queries the following: A holds that centuries are marked at their termination, and cites Gladstone for authority. B holds that centuries are marked at their beginning, and derides the intellectual Gladstone as guilty of this preposterous statement. Who has the better of the argument? A. The last year of each hundred gives the name to the century in which it is counted. We are now living in the 20th century. The last year of the 19th century was the year 1900. The first century began with the year 1 and ended with the year 100, and each century has followed the numbering of the first. This is exactly the same as counting other things. If you counted books, for example, you would count from one to one hundred, and the hundredth book would complete the first hundred books. A is right, although B calls his statement "preposterous."

(11006) G. M. says: Is the weight of the earth always the same, or is it getting lighter or heavier and what is the cause? A. The meteors which fall upon the earth in vast numbers every year add their weight to the earth. Thus the earth is increasing a minute quantity in weight each year, but not enough to be perceptible in thousands of years. Except for the escape of light gases from the atmosphere there is no known way in which the earth can lose weight.

(11007) G. W. M. says: Some time ago you published in the SCIENTIFIC AMERICAN a receipt for making gas from some kind of acids and aluminium; the paper I had has been lost and I would like to get it again if you can get it for me; find inclosed price for the paper. The gas I mean is so it can be lighted and made in a bottle. A. You can obtain hydrogen by means of aluminium in a variety of ways. The simplest method is to put chips of aluminium into sodic or potassic hydrate, using a rather dilute hydrate for the purpose. The mixture should be heated somewhat at first to start the action, but when the gas begins to come off the heat should be withdrawn or the action will be too violent. Another way is to pour hydrochloric acid upon the aluminium chips. This requires no heat. The chemical action will produce a great deal of heat. The acids of fruit will dissolve aluminium in the same way. For this reason aluminium cannot be used for cooking utensils. At one time it was thought that the metal would be of great service in the kitchen, but it had to be abandoned because the compounds formed from the acids of the food were harmful.

(11008) M. E. P. asks: 1. Give colors which have been adopted to indicate what a pipe is carrying. Ammonia pipes are painted one color and steam another, etc. A. There has been, to our knowledge, no sort of standardization of coloring of pipe lines to indicate their contents, and such standardization does not seem to us readily possible, as, if a list were made of all possible pipe contents of different plants, the colors most readily distinguishable from each other would be exhausted long before each content was designated. For instance, one plant may have steam, high and low voltage electric wires, and high and low pressure hydraulic; another may have steam, fire pressure, compressed air, electric wires, and gas, and one system of coloring to cover only those two plants will have already used up white, black, red, yellow, blue, and three other colors less readily distinguishable from the latter. A system must therefore be adopted to suit each particular plant, and the only important feature to be considered is that no two colors which may be mistaken for each other (as blue and green may be by lamplight) be used on adjacent lines, the accidental opening of one of which by mistake for the other in emergency would be dangerous (e. g., if a gas line were disconnected by mistake in looking for a short circuit in electric wires). For your case we would suggest black for steam, white for water, red for fire pressure, blue for ammonia, and yellow for brine circulation, or if there is no object in distinguishing fire from other water lines, red might be reserved for electric wire tubing, but in the light of the foregoing you can probably invent a better system for your special conditions than we can in ignorance of them. 2. What is the wind pressure per square foot at a velocity of 10, 20, 30 40, 50 miles per hour, respectively? A. The following are the pressures per square foot corresponding to the speeds in miles per hour given first:

10 miles per hour	=	0.492 lbs. per sq. ft.
20 miles per hour	=	1.968 lbs. per sq. ft.
30 miles per hour	=	4.429 lbs. per sq. ft.
40 miles per hour	=	7.873 lbs. per sq. ft.
50 miles per hour	=	12.30 lbs. per sq. ft.

3. How can I determine how much angle to give the blades of a propeller in order to get a certain pitch? A. The pitch of a propeller blade is exactly the same as that of any other screw, a propeller blade being only a section of the surface of a helix, that is to say, the pitch of the propeller is the amount by which any point upon it moves forward (in a direction parallel with the shaft) in one revolution of the propeller. Lay off a helix with the required pitch and the angle which its edge makes with a plane at right angles to its axis will be the angle at which the blades of your propeller must be set to a plane at right angles to the shaft to give the propeller the required pitch.

(11009) G. L. asks: What makes the earth move—not in regard to her three kinds of movements but simply what makes her to move, or in other words, what makes the matter move in the universe? A. The force which causes the earth to move is called gravitation. What its nature is is not known. It acts as if the earth had at some time been hurled into space in a line not directly toward the sun, but to one side of it, and had therefore moved around the sun ever since. Of course we do not think the earth was hurled in this way, but the effect of the attraction of gravitation is such as would have been the result if the earth had been thrown into space by a giant hand. Books of astronomy treat of these matters. One of the most recent is "Moulton's Astronomy," which we will send for $1.75 postpaid.

(11010) H. L. W. asks: In the issue of the SCIENTIFIC AMERICAN for October 3, 1908, in replying to "M. M." (Notes and Queries No. 10872), you say: "We do not know any reason why a person should be affected by lightning striking the water in which he is swimming." Some years ago I was swimming in Lake Luinrigamond, near Worcester, Mass., during a heavy thunderstorm. A very vivid flash of lightning occurred, the thunder being heard at practically the instant of the flash. Simultaneously with the flash, all my limbs contracted strongly, somewhat after the manner of a frog in Galvani's experiment, and I was conscious of a distinct shock comparable to that given by a strongly-charged Leyden jar. The shock was not painful, but was distinctly startling, so much so that I at once made my way back to the float. A friend sitting in bathing trunks on the wet float also said he felt the shock. We afterward found that the lightning had struck on the shore of the lake about a quarter of a mile distant. My knowledge of electricity is quite limited and I should quickly "get over my head" in a technical discussion, but the following explanation of the above facts seems tenable: While, as you state, "the earth is at 2,250 potential and of infinite capacity," would it not be true that at the instant of discharge that point of the earth which is struck by lightning is at a higher potential than the surrounding points? The potential is immediately equalized by the dissipation over the surface of the condenser (the earth) of the charge of electricity, the effects of the dissipation becoming weaker and weaker as the distance from the point of discharge is increased. Now a person submerged in a lake is in very intimate contact with the earth, and the discharge current, if I may use the expression, would pass through his body, as it would through all bodies of equal resistance, not insulated from the earth's surface, and if the current at this point were sufficiently strong, an effect would be produced in the swimmer's body, evidenced in my case by muscular contraction. There is nothing in this explanation except that you do not take cognizance of my assumption that at the instant of a discharge of electricity from a cloud to the earth, the zero potential of the earth is disturbed for an infinitesimal fraction of time, during which time a current is flowing from the point of discharge to be dissipated over the surface of the earth. A. We have read with interest your description of what happened to you when the lightning struck the water near where you were bathing. It would not appear that you experienced much of a shock from the electric discharge. Had you done so, you could not at once have made your way back to the float. It seems to us that your jumping in the water was as likely due to the suddenness of the flash and the sound of the thunder as to any other cause. Still we cannot say that it was so. If one did not experience more shock than from a discharge of a Leyden jar, the lightning was very weak. We entirely agree with your discussion of the conditions of the earth beneath a cloud at the instant of a lightning flash, but do not see that this alters what we said in the query referred to. That a certain degree of electrification should be dissipated from one would not give much of a shock. This is always experienced when lightning strikes in one's vicinity.

(11011) H. W. says: Why is it that, using the same effort and force, a long screw driver will remove a screw nail that cannot be moved by a short screw driver? A. The mechanical advantage gained is entirely and only due to the fact that the longer screw driver has the larger head, and consequently the greater leverage, i. e., the greater difference between the "arm of the power" as represented by the radius of the head and the "arm of the weight" as represented by the radius of the screw head (or half the width of the screw driver point). The only other advantages of the longer screw driver are the usual possibility of assuming with it a more comfortable position, using two hands instead of one, or throwing more weight against the screw driver to prevent the point jumping out of the screw head slot.

NEW BOOKS, ETC.

THE BOY'S BOOK OF STEAMSHIPS. By J. R. Howden. New York: The McClure Company, 1908. 12mo.; pp. 285. Price, $2.

The author has proceeded along very practical lines in the preparation of this admirable book, which will be welcomed not only by boys but by their elders. There is something fascinating about the modern steamship, and the admirable frontispiece, showing the "Adriatic" at Cherbourg, will bring back pleasant memories to many. Of all the works of man's hand and brain, nothing is quite so impressive or fascinating as a ship. Imposing as she may appear when in port, her hull is such a tiny thing when compared to the great and wide sea across which she ventures, that it seems almost impossible that any fabric put together by men's hands could possibly endure the great force of the ocean waves, still less make its way as unerringly as a ferryboat across them to a purposed destination. The author has tried to unveil to his readers the secret which lies behind it all, the secret, namely, of "freedom within the bounds of law"; that man is only permitted to control natural forces for his own ends by obedience to the laws which control them. A recapitulation of the chapters gives an admirable idea of the scope of the book. After an introductory chapter, we come to "Principles of Ship Design," "The Coming of Steam," "Down in the Stokehold," "The Engines," "Propelling Machinery," "The Development of Type," "The Comfort of the Passenger," "Navigating and Engineering Departments," "Steward's Department," "River Steamboats," "Lake and Coasting Steamers," "Ocean Steamships." There are many exceedingly valuable tables scattered through the book. These tables are so valuable, that one almost wishes that the author had called it "The Man's Book of Steamships."

BIOLOGY AND ITS MAKERS. By William A. Locy, Ph.D. New York: Henry Holt & Co., 1908. 8vo.; pp. 439. Price, $2.75.

The author has been frequently in receipt of letters from students, teachers, ministers, medical men and others, asking for information on topics in general biology, and for reference to the best reading on the subject. The increasing frequency of such inquiries and the wide range of topics covered have created the impression that an untechnical account of the rise and progress of biology would be of interest to a considerable audience. This the author gives as his reason for writing this book. This admirably fills a comparatively empty niche in the literature of science. The author has attempted to bring under one view the broad features of the biological progress, and to increase the human interest by writing the story around the lives of the great leaders, naturally the practical execution in the past resolving itself largely into the question of what to omit. The aim has been to keep in mind a picture sufficiently diagrammatic not to confuse the general reader. The book is divided into two sections. In the first are considered the sources of the ideas—except those of organic evolution—that dominate biology, and the steps by which they have been molded into a unified science. The doctrine of organic evolution, on account of its importance, is reserved for special consideration in the second section. The portraits with which the text is illustrated embrace nearly all the founders of biology.

THE STRUGGLE FOR AMERICAN INDEPENDENCE. By Sydney George Fisher. Philadelphia: J. B. Lippincott Company, 1908. 2 vols. 8vo.; pp. 573-585. Price, $4.

The present work is a continuation and an enlargement of "The True History of the American Revolution," published some years ago in one volume. That work, while being a brief general account of the contest, dwelt more particularly on certain phases of the struggle which have been omitted or ignored by historians. It soon became obvious that it did not go far enough, that the original plan should be extended and carried out in more detail, and that the whole mass of original evidence in libraries and historical societies should be made accessible, revealed to the public in as complete and ample form as possible. Our people have little or no conception of what the Revolution really was, no conception of the nature of the original evidence; and the unwillingness of our writers of general history to set forth that evidence keeps it a sealed book to the people. Our national feeling is bound up in the Revolution; the extreme importance of such an event, which was the foundation of our nationality and of the political and social principles by which we are still guided, seems to deserve all the light that it is possible to obtain. Although our Revolution is said to have changed the thought of the world, like the epochs of Socrates, of Christ, of the Reformation, yet no complete history of it has ever been written upon the plan of dealing frankly with all the contemporary evidence and withholding nothing of importance that is found in the original records. Our histories are able rhetorical efforts, enlarged Fourth of July orations, or pleasing literary essays on selected phases of the contest; there has been no serious attempt to delve in the original sources of information and reveal them to the reader, as has been done with the history of England, of France, and of other countries. In view of these facts, Dr. Fisher has written the admirable history which we are now reviewing. There is no one better qualified as a sound and accurate historian than Dr. Fisher, whose writings have been received with respect by all the reading community.

HOW IT IS DONE, OR VICTORIES OF THE ENGINEER. By Archibald Williams. New York: Nelson & Sons, 1908. 12mo.; pp. 484. Price, $1.25.

In these pages the reader will find an account of the great bridges built and in course of construction, and other great railway enterprises during the past few years, including tunnels and car ferries; also the story of the Florida East Coast Railway built over the sea. Ample space is given to the description of the new Croton dam and the Panama canal. The book is excellently illustrated by numerous well-executed engravings, a number of which have already appeared in the SCIENTIFIC AMERICAN.

IN VIKING LAND. Norway, Its Peoples, Its Fjords, and Its Fjelds. By W. S. Monroe. Boston: L. C. Page & Co., 1908. 12mo.; pp. 332. Price, $3.

The present work is the result of two vacation trips to Norway and rather wide reading of the extensive literature of the country. The author's aim has been to give prospective tourists some notion of the benefits to be derived from a visit to Norway, and to inform readers who prefer to travel within the covers of a book. The author also trusts that this book may serve to refresh the memories of those who have already traveled in Norway. In any country so rich in mountains, ice fields, and waterfalls and fjords, it is altogether easy to devote the chief part of a book to those forms and forces. This is precisely what most writers on Norway have done. The present volume, on the other hand, gives prominence to matters of human interest—the people, their habits, customs, and traditions, to the developed and developing civilization of the country. The Viking age appeals strikingly to the imagination of readers and travelers, and the author has endeavored to draw from the chronicles of the old Norse sagas and the existing historic objects which have visible connection with the past such facts as may aid in the construction of a fairly vivid picture of this stirring period. The author has produced a most interesting volume, which has been beautifully illustrated, printed, and bound by the publishers.

BRIDGE ENGINEERING. ROOF TRUSSES. A Manual of Practical Instruction in the Calculation and Design of Structural Steel Truss and Girder Bridges for Railroads and Highways. Including also the Analysis and Design of Roof Trusses and Other Details of Mill Building Construction. By Frank O. Dufour, C.E. Chicago: Published by the American School of Correspondence, 1908. 8vo.; pp. 384; 340 illustrations; half morocco; marbled edges. Price, $3.

The fact that this work by Prof. Dufour has been officially adopted as a textbook at the University of Illinois, is in itself convincing evidence of its value as a contribution to the literature of structural engineering. It is admirably adapted for the general practical use of the engineer. The problems involved in the calculation and design of modern steel structures are complicated, yet are adequately compassed here in a handy volume of moderate proportions. The treatment is exceedingly clear and concise, and free from the abstruse mathematics that ordinarily overburden other works in this difficult field. The section on Bridge Engineering treats fully both Bridge Analysis and Bridge Design, embracing the various types of truss and girder bridges, bridge piers and abutments, bearings, and other details, for railroads, country highways, etc. Every detail is clearly explained by the aid of diagrams, while graphical methods are chiefly used in the computations. The same practical and concise treatment marks the section on Roof Trusses, which covers all details of the analysis, calculation, and design of the various types of roof trusses used for buildings of various spans, the methods of securing good light and ventilation, the layout and other details of mills, shops, etc. Photographs of typical modern structures are shown, with full explanation of the methods followed in their design, and in some cases statements of cost.

A TEXTBOOK ON ROADS AND PAVEMENTS. By Frederick P. Spalding. New York: John Wiley & Sons, 1908. 12mo.; Pp. 340; 51 figures. Price, $2 net.

The methods employed in the construction and maintenance of highways have changed so greatly since the first publication of this book, that in the preparation of this edition it has been found necessary to practically rewrite the entire book. An effort has been made to briefly represent the best recent practice in highway work, and the book has necessarily expanded considerably beyond its former limits. The book contains chapters on "Road Economics and Management," "Drainage of Streets and Roads," "Location of Country Roads," "Improvement and Maintenance of Country Roads," "Broken-Stone Roads," "Foundations for Pavements," "Brick Pavements," "Bituminous Pavements," "Wood-Block Pavements," "Stone-Block Pavements," and "City Streets."

THE CAMPAIGN AGAINST TUBERCULOSIS IN THE UNITED STATES. Including a Directory Dealing with Tuberculosis in the United States and Canada. Compiled under the Direction of the National Association for the Study and Prevention of Tuberculosis by Philip P. Jacobs. New York: Charities Publication Committee of the National Association for the Study and Prevention of Tuberculosis. 8vo.; pp. 467. Price, $1.

This book has been made possible by the generous co-operation of the Russell Sage Foundation, which has supplied the necessary funds for its preparation and publication.

CENTENNIAL OF RELIGIOUS JOURNALISM. Edited by the Rev. J. Pressley Barrett, D.D. Dayton, Ohio: Christian Publishing Association, 1908. 12mo.; pp. 656.

CONSTRUCTIVE DRAWING. A Textbook for Home Instruction, High Schools, Manual Training High Schools, Technical Schools, and Universities. Arranged and published by Herman Hastein. Chicago, 1908. Oblong 4to.; pp. 33; 33 plates. Price, $1.

The author, who is a practical instructor in drawing, has applied an excellent series of problems, which will be found a great help for home instruction. This work represents the first year's course that has been followed the past twenty-five years in Chicago high schools and in the drawing departments of the Chicago Mechanics' Institute. A practical experience of seventeen years in the office and shop, and his occupation as teacher during the past thirty years, has given the author such judgment as to select only problems of practical importance to those who follow architectural, mechanical, and engineering vocations, as well as problems which are indispensable to manufacturing and industrial pursuits. The book is worthy of a good sale.

SECRETS OF THE ROCKS, OR THE STORY OF HILLS AND GULCHES. A Manual of Hints and Helps for the Prospector and Miner. By S. M. Frazier. Denver: Hall & Williams, 1908. 12mo.; Pp. 491. Price, $2.15.

There are prospectors' handbooks by the score, and scientific treatises on miners and mining by the hundreds, but have you ever seen a book which contained all the facts of the one and the theories of the other, and yet which was truly a story of the hills and gulches, told in such a way as to be full of the most intense interest, even to those who are not prospectors and miners? Such a book is "Secrets of the Rocks." Its author has been a practical prospector in the mountains of the far West for more than three decades, and during all that time he has been striving to learn the "secrets of the rocks" by personal observation and exhaustive study of the researches of others. He has embodied the results of his work in this book. The facts can be relied upon, for they are gleaned from actual experience.

GRAPHICAL DETERMINATION OF EARTH SLOPES, RETAINING WALLS AND DAMS. By Charles Prelini. New York: D. Van Nostrand Company, 1908. 8vo.; pp. 129. Price, $2.

A large part of this work consists of graphical methods of solving problems concerning the slopes of earth embankments, lateral pressure, earth against the wall, and the thickness of retaining walls and dams. These pages are intended for students, and not for professional engineers. Simplicity and clearness have been the main objects in view, and the experience of the classroom makes the author believe that this little work will be of use to students and teachers, while at the same time it may be of some help to the practical engineer.

AUDEL'S GAS ENGINE MANUAL. New York: Theo. Audel & Co., 1908. 12mo.; pp. 469. Price, $2.

A practical work dealing with all phases of the subject. There are 156 engravings. Among the interesting chapters are Gas Producer Systems, Ignition and Igniters, Installation and Operation of Marine Engines, Instruments Used in Testing, Nature and Use of Lubricants, Hints on Management and Suggestions for Emergencies, The Automobile, and Useful Rules and Tables.

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Scientific American Supplement 1538 gives the proportion of gravel and sand to be used in concrete.

Scientific American Supplements 1567, 1568, 1569, 1570, and 1571 contain an elaborate discussion by Lieut. Henry J. Jones of the various systems of reinforcing concrete, concrete construction, and their applications. These articles constitute a splendid text book on the subject of reinforced concrete. Nothing better has been published.

Scientific American Supplement 997 contains an article by Spencer Newberry in which practical notes on the proper preparation of concrete are given.

Scientific American Supplements 1568 and 1569 present a helpful account of the making of concrete blocks by Spencer Newberry.

Scientific American Supplement 1534 gives a critical review of the engineering value of reinforced concrete.

Scientific American Supplements 1547 and 1548 give a resume in which the various systems of reinforced concrete construction are discussed and illustrated.

Scientific American Supplement 1564 contains an article by Lewis A. Hicks, in which the merits and defects of reinforced concrete are analyzed.

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Scientific American Supplement 1574 discusses steel for reinforced concrete.

Scientific American Supplements 1575, 1576, and 1577 contain a paper by Philip L. Wormley, Jr., on cement mortar and concrete, their preparation and use for farm purposes. The paper exhaustively discusses the making of mortar and concrete, depositing of concrete, facing concretes, wood forms, concrete sidewalks, details of construction of reinforced concrete posts.

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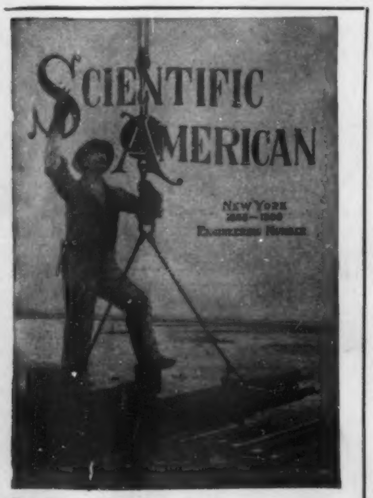

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